Chapter

Developing a Cloud Computing Framework for University Libraries

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Abstract

Our understanding of the library context on security challenges on storing research output on the cloud is inadequate and incomplete. Existing research has mostly focused on profit-oriented organizations. To address the limitation within the university environment, the paper unravels the data/information security concerns of cloud storage services within the university libraries. On the score of changes occurring in the libraries, this paper serves to inform users and library managers of the traditional approaches that have not guaranteed the security of research output. The paper is built upon the work of Shaw and the cloud storage security framework, which links aspects of cloud security and helps explain reasons for university libraries moving research output into cloud infrastructure, and how the cloud service is more secured. Specifically, this paper examined the existing storage carriers/media for storing research output and the associated risks with cloud storage services for university libraries. The paper partly fills this gap by a case study examination of two (2) African countries' (Ghana and Uganda) reports on research output and cloud storage security in university libraries. The paper argues that in storing university research output on the cloud, libraries consider the security of content, the resilience of librarians, determining access levels and enterprise cloud storage platforms. The interview instrument is used to collect qualitative data from librarians and the thematic content analysis is used to analyze the research data. Significantly, results show that copyright law infringement, unauthorized data accessibility, policy issues, insecurity of content, cost and no interoperable cloud standards were major risks associated with cloud storage services. It is expected that university libraries pay more attention to the security/confidentiality of content, the resilience of librarians, determining access levels and enterprise cloud storage platforms to enhance cloud security of research output. The paper contributes to the field of knowledge by developing a framework that supports an approach to understand security in cloud storage. It also enables actors in the library profession to understand the makeup and measures of security issues in cloud storage. By presenting empirical evidence, it is clear that university libraries have migrated research output into cloud infrastructure as an alternative for continued storage, maintenance and access of information.

Keywords: cloud computing, storage, security, research output, academic libraries, university libraries

1. Introduction

Despite the renewed interest in safeguarding research output, the changing storage carriers due to the fragility of storage carriers, lifespan, and handling practices are a cause of concern for the university libraries [1]. University libraries cannot avoid working in the cloud as they have become adaptive to inevitable and unpredictable changes occurring within the digital environment [1]. The university community places much emphasis on research and publication not only because it is presumed that research enriches teaching and the learning process, contributing to the body of knowledge, but also because it is a major determinant of institutional prestige and that of the nation at large [2].

Irrespective of the technological changes, stored research output in universities must be secured for future availability and accessibility [3]. Cloud storage has become an alternative for the storage of research output. According to Yuvaraj [4], university libraries have continued not only as only new technology adopters but rather cutting-edge IT users. Clearly, cloud computing as a cutting-edge IT platform proves to be a lasting technological innovation that continues to rise in usage [5].

However, owing to the technological age, university libraries are faced with new opportunities for innovative educational practices, hence providing electronic library services. Almost all university libraries are primarily concerned with enhancing teaching, learning, and research through the provision of timely information resources. On that basis, researches by Gabridge [6], Gold [7] and Jones [8] revealed the need for libraries to provide research data services. In providing timely information resources, modern libraries' digital collections must be stored for future use and as backups to ensure continuous accessibility by library users.

Witten and Bainbridge [9] explained that a digital library is a focused "collection of various forms of digital objects" such as text, audio, and video, as well as their methods for access, retrieval, selection, organization, and maintenance. Rosenberg [10] also reiterated that a digital library can refer to information resources which are accessed by and delivered to users electronically or via a network [11]. Primarily, in developing countries, microfilms, databases, CD-ROMS, hard disks, external drives have been the existing platforms for storing library digital information, though these come with major drawbacks. For instance, these storage devices are exposed to threats such as theft, inadequate storage space, virus attacks and unauthorized accessibility among others. These drawbacks have been a major concern for academic libraries' thus an ongoing debate and discussion on the new technology "cloud storage" as an alternative storage media.

To a large extent, studies confirm that modern university libraries have greatly shifted from traditional roles (paper-based services) to digital library services. This paradigm shift has paved the way for library services to be accessed and delivered via the web [12]. For university libraries, the issue of using cloud services to store digital collections is particularly important as technological changes have paved the way for library services to be accessed and delivered via the web [12]. As more data and information is generated and stored in the cloud, either by design or default, university libraries need to be confident of the security of the digital collections. There is a growing interest in the implementation of cloud storage services which exposes university libraries to a new set of threats and vulnerabilities. McLeod and Gormly [13] concluded that if cloud service providers are to be used, their security, viability, sustainability, and trustworthiness must be paramount.

Studies have demonstrated that that cloud computing in libraries has widely examined the rise of data-intensive services in academic libraries with less emphasis on cloud storage security [14, 15]. Most of these studies were based on individual

or small-scale survey data concentrated in one country. Owing to the extant gap in wide-scale exploratory studies, the present paper explored the risks associated with cloud storage services and how university libraries can ensure safe research output. In this light, the paper contributes significantly to the body of literature by unraveling new evidence from universities located in Ghana and Uganda on how academic libraries can secure research output with cloud services.

The following sections include research questions, related literature, theoretical framework, research methodology, results, a summary of key findings, conclusion and recommendation.

1.1 Research questions

i. What are the existing storage carriers/media for storing research output in university libraries?

ii. What are the reasons for university libraries moving research output into a cloud infrastructure?

iii. What risks are associated with cloud storage services for university libraries?

iv. In university libraries, how can research output store on the cloud service be secured?

2. Related literature

2.1 Storage media in university libraries

Libraries use several types of media in storing digitized content or information (audio, video, text, images etc.). Each of the media suffers disadvantages with regard to reliability, high lifespan, ease of access and validation plus various costs. Enakrire and Baro [16] argued that these media include;

i. **Magnetic disk drives** are disk drives which are mostly mounted on computers. They are inexpensive, of very high-density, fast to use, and multiple user connectivities to the server are possible.

ii. **Magnetic tape**, which comes in various formats and can only be effective for duplicate or backup copies. However, they are not recommended for primary storage.

iii. **Optical disks**, for example, CD-R and DVD-R cost less, use low energy but exert high labor costs, poor accessibility, a periodic verification is not cost-effective and low density by today's standards. Others are CD-RW and DVD-RW these are recommended for individual and day-to-day use but are not recommended for data preservation [17].

2.2 Cloud storage services

Until recently, evidence from the pool of literature shows that the concept of cloud is of the growing research area. Indeed, a lot more storage capabilities exist in the cloud. According to Mavodza [18], cloud computing is the delivering of hosted electronic services over the internet. Scale [19], opines that it is: "the sharing

and use of applications and resources of a network environment to get work done without concerns about ownership and management of the network's resources and applications, data are no longer stored on one's personal computer, but are hosted elsewhere to be made accessible in any location and at any time". Gosavi et al. [20] iterated that cloud computing harnesses the capabilities of resources like storage, scalability, and availability, which are accessible to university libraries as clients. Hence, depending on the needs of the clients, the infrastructure can be scaled up or down.

In developed or developing countries, cloud storage provides promising advantages to university libraries. According to Li [21], cloud storage reduces the cost of hardware and software, and it makes the storage and management of data on the internet possible. It also reduces the work of Information Technology (IT) professionals as most of the system's work is performed by the hosting company. Payment for the cloud storage service is by pay-as-you-go, which is convenient for organizations such as academic libraries which have budget restraints. Han [22] enumerates cost-effectiveness, flexibility, and data safety as a rationale for cloud storage in academic libraries. Han [23] alludes the advantages that cloud storage has over traditional storage to "availability, scalability, off-site storage, on-demand, and multi-tenancy" which allows different applications or different users to access the same resources to fit their needs. Han further states that data stored in the cloud can be easily transferred and duplicated globally to minimize data loss due to natural disasters.

Haris [24] also gives an analysis of the benefits of cloud storage especially for libraries and these include high performance, an avenue for collaboration, less "need for in-house technical expertise, cost savings, and more timely access" to the latest IT functionality. Haris further states that the cloud also provides a better workflow, "automated software updates, redundancy", and backups. Cloud storage provides collaboration, particularly for academic and research libraries. Through the use of cloud technology, a collaboration between libraries, researchers, and students is promoted. The cloud also enables remote access to a wide range of research materials.

2.3 Reasons for cloud computing in university libraries

In this section, the role of cloud computing in university libraries, specific cloud storage platforms and the risks associated with cloud storage are reviewed.

Kaushik and Kumar [25] contend that cloud computing can offer many interesting possibilities for institutions such as libraries. Cloud computing is quite significant as it reduces technology cost, increases capacity reliability, and storage performance for some type of automation activities like library services. In recent times, cloud computing has made strong inroads into other commercial sectors and is now beginning to find more of its applications in the library and information environment.

After the personal computer and the internet, cloud computing also known as the third revolution is completely new in terms of technology. Potentially, cloud computing is an unraveled technology in university libraries as digital content can be stored in the cloud. Mobile devices are enabled using cloud computing by taking out an item or scanning a barcode [26]. Gosavi et al. [20] argued that when using cloud computing, users can be able to browse a physical shelf of books located in the library, choose an item or scan a barcode into his mobile device. More so, heritage materials or documents can be digitized, searched and accessed by library patrons. The new concept of cloud libraries includes OCLC, Library of Congress (LC),

Exlibris, Polaris, Scribd, Discovery Service, Google Docs/Google Scholar, WorldCat and Encore [27].

Nowadays, studies appear to be emerging in cloud computing. For instance, a paper presented by Saleem et al. [27] indicated that university libraries have adopted cloud computing technology to enhance library services by adding more values, attracting users and cost-effectiveness. In the cloud computing environment, clouds have vast resource pools with on-demand resource allocation and a collection of networked features. The new concept of cloud and libraries has generated a new model called cloud libraries.

In the work of Zainab et al. [28], it was reported that the first reason of shifting research report into cloud computing is to reduce the total cost of ownership and maintenance of the cloud infrastructure. Secondly, scalability of the cloud service system is another objective, so that it is able to handle increased traffic. Due to the rapid expansion of the user group, we need to redesign the back-end web server with scalability in mind, such that it is able to accommodate an increasing number of concurrent users.

Based on the web traffic statistic, the average visit per month for the year 2012 is approximately 87,000 users and we expect the numbers will grow in the coming years as resources in the repository also grew. The high volume of transaction is causing The server to behave extremely sluggish and crashes frequently [28]. On the hand, migration is necessary in order to meet the increasing demand for storage space for full-text digital resources. File sizes of some digital resources are extremely large especially audio, video and images. Besides, as more users' access and upload articles to the magnetic hard drives, university libraries face problems in fulfilling the storage space demand. The cloud storage service which promises and contributes to about 13 terabytes of storage space, can store over 12 million digital files of research output. Thus, it is very obvious that without a long-term plan, university libraries would not able to sustain the present storage demand from users in the future until alternative storage is assessed.

It is expected that migration of digital files would reduce downtime when scheduled backup and indexing, as well as site traffic, occur simultaneously. The previous system backup was very laborious and time-consuming. Often scheduled jobs would cause unnecessary downtime of the magnetic and optical systems. System downtime is unavoidable because the system was hosted without a redundant server.

2.4 Enterprise cloud storage platforms

Amazon S3: Amazon Simple Storage Services (Amazon S3) provides a secure, durable, highly-scalable object storage (Amazon, 2015). It uses a web service interface to store and retrieve any amount of data. It is a pay as you use service. There are different storage classes designed for different uses; Amazon S3 standard, Glacier for long-term archive. The services include backup and archiving, disaster recovery, and big data analytics [29].

Google cloud storage: Allows storage and retrieval of any amount of data at any time. It facilitates the storage of data on Google's infrastructure with high-reliability performance and availability (Google, 2015) [29]. The services include data storage, large unstructured data objects, uploading data, and managing data. The lowest storage class is $0.01 GB/month.

Microsoft Azure: Azure supports the selection of wide services including operating systems, frameworks, tools, and databases. It's typically a platform-as-a-service and software-as-a-service. It provides secure private connections, storage

solutions, and data residency and encryption features (Microsoft, 2015). It provides scale-as-you-need, pay-as-you-go service plan, and strong data protection security.

Other cloud storage platforms include Dropbox, SkyDrive, Box**,** Google Drive**,** Flickr**,** Google music**,** Apple iCloud, and Amazon cloud player.

2.5 Associated risks and possible solutions for cloud storage

Lili and Buer [30], highlighted that advancement in technology may not necessarily transform the cloud services into mainstream technology in academic libraries. A scan of literature [31–33], revealed that cloud security, interoperability, and regulatory perspectives are worrying. In addition, academic libraries may or may not completely lose control over IT and data. Sometimes, trust in the service provider, data portability, migration, copyright issues, and privacy is a big risk when it comes to adopting cloud computing technology.

2.5.1 Policy issues

Policies guide institutions and operations on what to do and not to do. Cloud storage and applications are valuable resources that allow academic libraries to store large amounts of information and perform collaborative tasks more effectively. However, there are risks associated and that must be mitigated in order to properly secure the research assets placed into the cloud [32]. In this light, it is purposeful for the policy to provide the framework within which the libraries will be expected to operate for storage and process information in cloud environments. Basically, the policy should encompass the scope of work, software, research information, human resource, users, copyright and many more.

2.5.2 Unauthorized accessibility

Once a digital collection (scholarly works, publications/collections, and historical documents) is put on the cloud, it becomes available for all groups of users and this can be exposed to unauthorized access to data centers. "*Cloud operators can dictate the manner in which users can access, use and reuse content or information via specific online services or applications. That is, the user interface ultimately dictates what can or cannot be done by end-users, regardless of what they are theoretically entitled to under the law*" [34]. So, the question is whether academic libraries can allow such law to be overridden on as it has already fallen in the public domain. This indeed is likely to impact on copyright law in the context of online applications.

2.5.3 No interoperable cloud standards

Cloud storage service providers are not guided by standard regulations. As a result, some service providers are tempted to offer low-quality services to developing countries in Africa thus creating loopholes for cybercriminals to take advantage. As an emerging trend, this issue of no interoperability is of concern, if research assets can be secured on the cloud. Interoperability refers to the ability of a collection of communicating entities to share specific information and operate on it according to agreed-on operational semantics [35]. Even though the clients (academic libraries) desire standards for cloud interoperability, the reality currently is that standard efforts only focus on portability, which is the ability to migrate workloads and data from one provider to another.

Librarians cannot sit unconcerned in this matter since the open access (OA) repositories are also part of collections of the library [36]. Though the OA

repositories facilitate sharing of resources in educational research through portals that are modeled as gates to several repositories, it is a challenge because data synchronization is an issue when components in different clouds or internal resources work together, whether or not they are identical. Communication between clouds typically has a high latency, which makes synchronization difficult. Also, the two clouds may have different access control regimes, complicating the task of moving data between them [37].

Thus, interoperability is required, not just between different components, but between identical components running in different clouds [38]. Such components often keep copies of the same data, and these copies must be maintained in a consistent state. The design approach must address management of "system of record" sources, management of data at rest and data in transit across domains that may be under control of a cloud service consumer or provider and data visibility and transparency.

Nurnberg et al. [39] argued that full interoperability includes dynamic discovery and composition: the ability to discover instances of application components and combine them with other application component instances, at runtime. Application interoperability requires more than communications protocols. It requires that interoperating applications share common processes and data models. These are not appropriate subjects for generic standards, although there are specific standards for some particular applications and business areas.

2.6 Cost

Obviously, the cost is a challenge for academic libraries. More especially, enterprise cloud storage platforms such as Amazon S3 and Microsoft Azure are paid for as you use the cloud services. Unfortunately, libraries that find it difficult to fund basic services will see that as an extra cost inhibiting them to withdraw from the cloud service. The cost comes with human resource and sometimes maintenance of servers.

3. Theoretical framework for cloud storage security

The paper adopts the development of a Cloud Storage Security Framework (CSSF) to support an integrative approach to understanding and evaluating security in cloud storage in university libraries. The framework enables understanding

Factor	Item
1. **Cloud Storage Security**	1. Cloud Storage Security Policies
	2. Cloud Storage Security Procedures
2. **Confidentiality**	3. Identification of cloud storage user
	4. Authorisation to access data
3. **Integrity**	5. Accurate ownership of data
	6. Encryption of data
4. **Availability**	7. Accessible to the data
	8. Up-to-date available data
5. **Non-repudiation**	9. Accurate time-stamping of accessed data
	10. Assurance with user signature
6. **Authenticity**	11. Verified data based on authentication
	12. Synchronised data in the storage
7. **Reliability**	13. Consistency of cloud service
	14. Valid service
Factors: 7	Items: 14

Figure 1.
CSSF. Source: Yahya [40].

of the makeup of cloud storage security and its associated measures. Drawing upon CSSF, it indicates that security in cloud storage can be determined by seven factors: (1) security policies implementation in cloud storage, security measure that relates to (2) protecting the data accessed in cloud storage; (3) modifications of data stored; (4) accessibility of data stored in cloud storage; (5) non-repudiation to the data stored; (6) authenticity of the original data; (7) reliability of the cloud storage services.

The framework is summarized in **Figure 1**.

In applying the framework to the current research, security of research output in the cloud infrastructure can be determined by ensuring that all the seven factors are met by the university library.

4. Research methodology

This study aimed to explore security issues considered in migrating research output to the cloud service as input into the development of preservation or storage systems within the library environment. This section described an approach followed in the study. This included the research approach, purpose, instrumentation, and sources of data. Our paper adopted the qualitative approach to explore cloud computing in university libraries in the sub-Saharan Africa. Using a wide range of evidence and discovering new issues, the purpose of the paper was to explore the risks associated with cloud storage and security implications. The exploratory design was significant as the authors became more familiar with basic facts, settings, concerns, and generating new ideas. In this study, interviews were conducted with respective librarians in charge of research output within the (4) universities. Hence, the research sites were purposefully selected to ensure that they provided sufficient opportunities to test available infrastructure for storing research output. Again, since the paper was interested in only libraries with repositories, the institutions without OA repositories were excluded.

An interview schedule on the research questions was presented to 4 librarians from the universities. Thus, participants for the investigation were made up of librarians in charge of institutional repositories. These four university libraries selected were; Balme Library, (University of Ghana—Legon), Kwame Nkrumah University of Science and Technology—KNUST library (Ghana), HamuMukasa Library, (Uganda Christian University), and The Iddi Basajjabalaba Memorial Library, (Kampala International University—Uganda). The thematic content analysis was used to analyze the qualitative data. The authors further reviewed scholarly research articles, explored in the context of research data storage in and outside Africa.

5. Results

This section draws reference from respective university libraries in the context of cloud storage security for research data.

5.1 Balme Library, University of Ghana, Legon

The University of Ghana (UG), the premier university and the largest university in Ghana was founded as the University College of the Gold Coast by Ordinance on August 11, 1948, for the purpose of providing and promoting university education, learning and research. The vision of the university is "to become a world-class

research-intensive University over the next decade". To achieve the vision, it "will create an enabling environment that makes the University of Ghana increasingly relevant to national and global development through cutting-edge research as well as high quality teaching and learning" (http://ug.edu.gh). To achieve this mountainous vision in the next decade, the Balme Library, the central library of the university plays a crucial role.

Established in 1948, the Balme Library is the main library of the University of Ghana. In addition to the Balme Library, there are other libraries in the various Schools, Institutes, Departments, Halls of Residence and the Accra City Campus which form the University of Ghana Library System (http://balme.ug.edu.gh).

In UG, research assets (theses, journals, newspapers) in the form of PDFs, word files, conference papers, videos, and audio have been generated. In the context of this study, the existing storage media for storing research data include CDs, DVDs, external drives, servers, hard drives, microfiche, and microfilms. Others include networked drives, Google drive and Dropbox used by researchers and the library in storing research assets.

The interviewee indicated that digital storage and backup is important because;

> *"Data may need to be accessed in the future to explain or augment subsequent research. Other researchers might wish to evaluate or use the results of previous research outputs as precedence to conduct other similar or extended studies".*

Agrawal and Nyamful [41] corroborated the findings in the present study. Accordingly, they reported that storage devices which stores and maintains large sets of data over time play an important role in mitigating big data challenges. Factors such as capacity, reliability, performance, throughput, cost, and scalability are involved in any ideal storage solution system. They argued that reliability is basically the retrieval of data in its original form without any loss. The issue of reliability takes into account both internal and external system failures and vulnerabilities. With the scale of data, the probability of losing some data during retrieval can be very high. In order to ensure continuous accessibility of data, storage is very necessary.

It was revealed by the interviewee that

> *"there is no robust or enough backup plan when the primary server goes down. With an average of 3000 visits per day on the Institutional Repository (IR), we wish to keep The website availability as high as possible. To solve the problem, the IR team decided to move digital files to a cloud environment using virtualization technology".*

A study by Ji et al. [42], revealed a compelling need for storage and management of research output. Given the current development of data (text, audio, video, images, etc.), university libraries are employing techniques such as data compression, deduplication, object storage, and cloud storage.

The Librarian in charge of research data opined that

> *"Unauthorized accessibility, physical damage, theft, and hacking are particular concerns with electronic data. Many research projects involve the collection and maintenance of human subject's data and other confidential records that could become the target of hackers and thus integrity must be maintained. The costs of reproducing, restoring, or replacing stolen data and the length of recovery time in the event of a theft highlight the need for protecting the computer system and the integrity of the data".*

The Librarian iterated that several issues are associated with storing research data on the cloud.

One interviewee pointed out that;

> *"Risks associated with cloud storage are crucial for the Balme Library. Storing research assets online via the Dropbox, mozy.com, Box.net, Adrive.com, Carbonite.com have proven the best alternative. However, a few associated risks include issues regarding property rights, copyright, data protection licenses or privacy. Other issues to consider is the fact that in the event of restoring data, it may be a bit slow and the service provider (Google Reader) could go out of service".*

5.2 KNUST

KNUST Library has realized the need to digitize and store documents and research data generated by staff and students of the University, hence the decision to create the online Institutional Repository. The online repository showcases the intellectual output from the KNUST. In the earlier 2010, a server and scanners were acquired to support digitization processes. Since then, postgraduate thesis, reports, and few research articles have been uploaded unto the repository. Increasingly, the project has continued to receive acclamation internationally due to robust IT infrastructure in the library.

The librarian for KNUST responded in this manner,

> *"Currently, the KNUST uses non-web based storage media to store data. There are two servers; one for the Library's catalogue and another for the Institutional Repository. The library also uses an external hard drive as a backup, but both media are located in-house".*

Reed et al. [43] asserted that "data backup plays an indispensable role in the computing system. Backup is one way to ensure data protection. By keeping copies of production data, backup protects data from a potential loss such as hardware and software loss, human errors, and natural disasters. The huge amount of data needing backup and archiving has reached several petabytes and may soon reach tens, or even hundreds of petabytes. The massive amount of data in today's library environment may consume much storage."

Furthermore, it was reported by the interviewee that

> *"The challenge faced with this kind of storage media is frequent memory crash, lack of expertise to manage the storage media, lack of space – the servers have low memory space, an interrupted power supply which uninterruptible power supply (UPS) is not even able to solve. Then finally, remote access to the information is denied because data is not online". Thus, the need to seek cloud storage.*

It was evident from the interviewees that cloud computing environments are easily scalable and backup recovery is very easy in Infrastructure as a Service (IaaS) Providers, hence there is efficient incident response whenever data needs to be recovered.

The authors sought to find what risks were associated with cloud storage. Cost and data security were concerns raised by the managers of the repositories. Agrawal and Nyamful [41] argued that the state of preventing a system from vulnerable attacks is considered as the system's security. Security risks involved

with the use of cloud computing have various risk factors for the library environment. Seven important identity factors for risk in a cloud computing model are access, availability, network load, integrity, data security, data location, and data segregation.

5.3 Hamu Mukasa Library, Uganda Christian University Library

Uganda Christian University has been in existence for 11 years having only one library which uses traditional devices. In the year 2015, the library launched its institutional repository. The storage media for storing research data in Uganda Christian University library is examined as follows:

Uganda Christian University has both traditional and modern storage devices. Traditional storage includes CDs, flash disks, card catalog and later introduced modern storage like creating an institutional repository where dissertations and research papers are kept safely for future use.

The Librarian in charge of the research data output of the Uganda Christian University observed that;

> *"For modern storage devices, Google drive is currently used to store documents such as student Theses works, proposals, and the day to day statistics. This started early last year when the learning commons was opened. This is used because it is cheap and can be accessed easily by staff and students while doing their work".*

In this twenty-first century, information is not just in print but digitally created and reused by researchers and patrons within academic institutions. There is a need for digital information storage at Uganda Christian University because of the advantages. Prior to cloud storage, institutions invested heavily in data centers and servers even though they may not have used its storage space. The cloud storage allows institutions' (academic libraries) only pay for computing resources they use. By using cloud storage one can achieve a lower variable cost than can be gotten on the traditional storage devices.

However, using cloud storage by Uganda Christian University academic library has some risks. Lack of internet access or less bandwidth is a major issue. Specifically, when the internet is down its difficult for data to be retrieved thus inconveniencing the patrons. Secondly, sensitive information for the institution can be disclosed accidentally or deliberately in cloud services if not handled well especially when demand grows. Thus, the inappropriate accessibility of the institution data can be compromised.

For an institution like Uganda Christian University Library to ensure the safety of its research information in the cloud, the following must be considered.

- avoid unauthorized accessibility of research data using strong passwords.
- Privacy policy services settings must always be checked by appropriate management.

5.4 The Iddi Basajjabalaba Memorial Library, Kampala International University-Uganda

The Iddi Basajjabalaba Memorial Library (The IBML) is an integral part of Kampala International University (KIU). It is the intellectual hub of the university that supports the study, teaching, research and social information needs of the university. The IBML has grown over the years from one small room in 2001

manned by one member of staff and serving 700 users to an eight ultra-modern building serving over 20,000 users. The IBML system has evolved over time from the manual system providing print information resources to automated circulation services and digital information resources. In 2014, The IBML set up a digital repository to capture, store, and disseminate the intellectual content of the university. The digital content includes research articles, papers written by university staff, PhD theses, and other university publications. DSpace software was used for this project and it is hosted locally on a networked server. The repository data is backed up on an external hard drive with several terabytes of storage capacity.

The IBML has not ventured much into cloud storage because data is still stored locally. Researchers, academic staff, and students typically use external hard drives, flash disks, CDs, DVDs, emails and Google Drive to store their data. Not many use Dropbox, OneDrive, and other Cloud storage media. However, this trend is risky because the library faces several challenges especially power outages that lead to a computer crash, theft of computer hard drives, and other storage media. There is also a danger of data breaches by unauthorized persons since the repository server is not within the confines of the library. Therefore, cloud storage is an important choice for the library to use in order to mitigate the danger of data loss.

Figure 2 depicts how university libraries provide library services via cloud services. Due to the unreliability of non-web based storage media, university libraries have refocused attention to an alternative; cloud service which is web-based. In providing library services to university faculty, students and researchers; research assets in the form of electronic theses/dissertation, articles, research datasets, research reports are stored in the cloud. It is important to note that cloud services provide advantages like large storage space, data back-up among others which non-web based media does not have. However, alternative storage media (cloud computing) appears to accommodate the concerns of university libraries. Putting in place, security of content, defining accessibility levels, adherence to copyright and legal issues, cloud storage policy, among others, safety of research assets on the cloud service is safer.

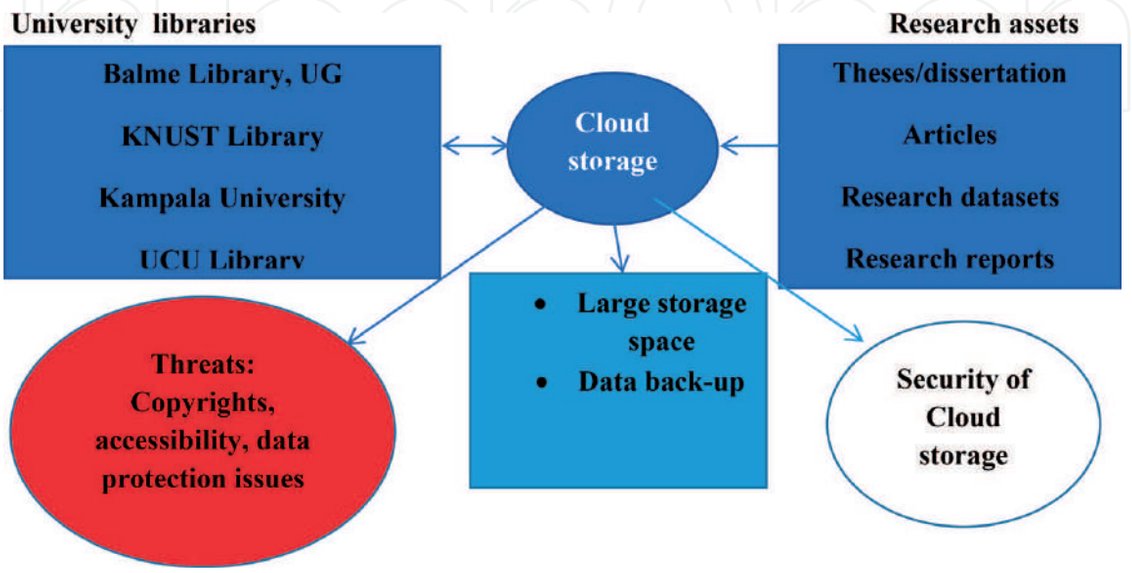

Figure 2.
Cloud computing in university libraries.

6. Summary of key findings

The paper discovered pertinent and important findings which were very vital for drawing a conclusion and informing policy makers.

6.1 Existing storage media for research assets

From the study, it can be concluded that all the sampled academic libraries used magnetic disk drives (hard disk drives) for storing research outputs and assets and optical disks (CD-R and DVD-R).

6.2 Need for digital information storage

From the empirical evidence, it is concluded that information enhances knowledge, which affects behavior, and leads to development warranting its preservation. University libraries have the digital format as text, audio, video, and image which facilitates easy sharing of information. Storage is needed for current and future generation of researchers and academia as a whole. In addition, digital storage makes information easily accessible to users as compared to "analog items". This is due to the ability to easily copy the information on storage devices and carry around. Furthermore, digital storage facilitates the easy sharing of information.

6.3 Risks associated with cloud storage in university libraries

Specifically, copyright law infringement, unauthorized data accessibility, policy issues, the security of content, no interoperable cloud standards were identified as the risks associated with cloud storage in academic libraries.

6.4 Conclusion

Cloud computing offers university libraries improved storage solutions. In the era of IT, the library and information environment face numerous challenges including constant change of storage platforms. Notably, the storage of research output is primary to the functions of university libraries. Thus, there is a need for storage security; as it is a reality in the current technological environment.

In the developed world, some university libraries have already built and managed their own research data centers comparable to the developing world. Indeed, to avoid loss of data integrity, large digital storage in the cloud must be backed up, maintained and re-produced to avoid stress on the local server infrastructure. In conclusion, the opportunities offered by cloud computing via its storage services could ensure that university libraries gain more control over research output.

University libraries must consider investing in cloud infrastructure as it assures large savings or cost effectiveness in operational cost and tech-start-ups [44], paying for what you use and risk transfer and availability [45], scalability, accessibility [4], on-demand service, access to a large network, rapid elasticity and resource sharing [46]. Above all, Gosavi et al. [20] pointed out that libraries are likely to benefit from cloud storage in the area of self-healing, multi-tenancy, linearly scalable, service-oriented, SLA driven, virtualized and flexibility of services.

The paper contributes to knowledge by protecting research data in cloud storage systems. Furthermore, the implication of the findings gives significant input to policymakers, information professionals and future researchers. Finally, with qualitative data, the adopted framework indicates how the security of cloud storage can be implemented successfully.

6.5 Recommendation

The authors recommends the following; security/confidentiality of content, the resilience of librarians, determining access levels and enterprise cloud storage platforms if research output can be secured on the cloud;

6.5.1 Security of content

Content concerns raised by Cave et al. [47] and Genoni [48] require consultation with legislation or the legal office of the academic institution. This is to say that the type of records and length of time for keeping research output must be determined, and policy put in place. In a fast-changing library environment, the technology for storage of research output suffers from obsolescence hence the need for regular back-ups to avoid data loss. Whichever way one considers the issue, storage and access concerns are central, leading to the consideration to make the cloud a viable option.

6.5.2 Resilience of librarians

There is a need for university librarians to maintain the character of resilience and also be adaptive to inevitable and unpredictable changes that occur at an accelerated pace. It is therefore required of librarians to provide a wide variety of information from an equally varied selection of sources and formats through teams (working together) and particularly with the prevalence of cloud use. Since cloud computing enables almost a new streamlined workflow, cooperation through team building or network can be very laudable.

6.5.3 Determining access levels

To overcome the enumerated challenge of unauthorized access to data centers, academic libraries must be concerned with the levels of accessibility; ranging from completely open access to highly private. In securing the content of the research assets on the cloud, different levels of accessibility or privileges must be assigned to the different users within the network. For instance, students, researchers, librarians, users outside the university community must be assigned roles as such.

6.5.4 Enterprise cloud storage platforms

The authors highly recommends the enterprise cloud storage platforms such as Amazon Simple Storage Services (Amazon S3), Google cloud storage and Microsoft Azure. This is because they provide secure, durable, highly-scalable object storage, allows retrieval of any amount of data at any time and high-reliability performance and wide services including operating systems, frameworks, tools, and databases.

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Chapter

e-Governance and Anti-Corruption War in Africa: The Nigeria Experience

John Sunday Ojo

Abstract

The failure of traditional governance model to provide solution to the contemporary challenges in the public sector has elicited the advent of sophisticated technological response that provides a placid environment for digitalizing public administration across the world. The development of ICTs therefore brings transformation in the way and manner of governing the citizens in Africa and the global community. The transition from governance to e-governance has been considered as a veritable instrument in ensuring transparency, accountability and effective service delivery in the public sector. The potency of ICTs as a supporting tool in curbing the pervasiveness of institutional corruption in Africa is acknowledged. Globally, Nigeria is recognized as one of the most corrupt countries in the world, corruption has been a major problem setting-back the advancement of the country. In taming the obnoxious trend, the recent public sector reform championed by the Nigerian government aimed at providing sanctity in the management and utilization of public resources with the application of ICTs geared toward combating corruption has gained momentum. These institutional reforms provide a platform for e-governance in managing public resources for the benefit of the citizenry. Therefore, this chapter provides a critical examination of e-governance model employed in tackling corruption in Nigerian public sector.

Keywords: corruption, anti-corruption, e-governance, transparency, Africa, Nigeria

1. Introduction

Technological advancements have been credited for playing a significant role in the globalization of trade, communication, economics, politics, culture and life styles. Thus, modern communication technologies or information and communications technologies (ICTs) have been ascribed to not only improving efficiency or productivity in the business world but also with improving the standard of living for the global citizens. One of the strategies is the application of e-governance which entails the use of Information and communication technologies (ICTs) in managing governmental business in the region. Information and communication technologies (ICTs) were the stimuli behind the economic, political and social revolution since the invention of the digital computer (mid-1940s), which were accelerated with the advent of the Internet (the early 90s). Currently, the work of public institutions depends increasingly more on the technical and architectural choices that are made at the level of technology. Most of the principles of good governance are expressed in

the roles of e-government; in other words, focus on transparency, openness, citizen participation, effectiveness, efficiency, accountability and the likes [1]. The implementation of e-governance to carry out public services has become a global drive in public administration. It is aimed to develop a robust environment for efficiency in managing public affairs. Since 1960s through 1970s, as information technology emerged, it has been envisaged that the use of modern technology would bring revolution to the way and manner of running governmental businesses. As information communication continues to dominate the space of all organizations especially in the 1980s and 1990s, the political office holders' arrogated recognition for the implementation of information communication technologies (ICTs). Toward the beginning of twenty-first century, the application and the use of ICTs became more popular among the citizens and public officials [2].

In the management of public affairs, corruption has been recognized as one of the dominant problems in promoting economic growth and the welfare of the citizens [3]. Corruption has been acknowledged as a fundamental challenge to good governance and development, habitually embedded in the Global South. Although, it is not only restricted to the region, nonetheless, chronic poverty, conflict and discrimination embedded in developing states are accredited to be responsible for promoting corruption [4]. To combat the increasing level of corruption in developing nations, there are sundry measures put in place to checkmate the syndrome in the public sector. One of such approaches is the e-platform which provides a modern approach to promote anti-corruption agenda, resulting in accountability and transparency in the overall management of public affairs [1]. Thus, e-governance should be considered as a digital mechanism for mitigating corrupt practices in the public sector. Accessible public information for all citizenry can bring about transparency, which limiting public official to demand or accept bribe. One of the major approaches in reducing corruption in the public sector is to limit interaction between the citizens and public officials. This can ensure not only providing accessible information regarding government activities but removing the bureaucratic bottleneck inherent in public administration. Even though e-governance is not the first and last method to be employed for anti-corruption campaign in the public sector, it is being practiced very efficiently in the developed countries and in a few developing countries as well. In general, both developed and developing countries have succeeded much in implementing e-governance, although with relatively uneven attainments. Their efforts to apply the tools and strategies of e-governance have been visible since the last couple of decades. There are countries especially in Asia which have effectively utilized e-governance in reducing corrupt practices and promote good governance. These include The Republic of Korea, Singapore, Japan, Israel, Bahrain, Malaysia, and Sri Lanka [5]. There are other countries in developing nations that have embarked on such a giant stride to fight corruption, albeit they have lagged behind in the effective implementation of e-governance. International organizations such as Transparency International (TI), United Nations Development Programme (UNDP) and World Bank (WB) among others have reinvigorated the need to implement modern technology against the traditional approach in managing government activities [4]. Therefore, this chapter aims to provide the nexus between e-governance and anti-corruption strategies in Africa by exploring the application of e-governance in Nigerian anti-corruption campaign.

2. Transition from governance to e-governance

The traditional concept of governance emerged from the Greek language (κυβερνᾶν), which connotes "to steer". The concept transcends a mere existence

of government. In all societies, people employ governance in their daily lives to manage human relationship, interaction and activities. In this context, the use of governance can be metaphorically referred to steering of a ship. Actually, steering of a ship requires navigation toward a particular direction, and this necessitates an existence of seamanship who is saddled with the responsibility of navigating the ship toward certain destination. Thus, governance as a process requires steering of people toward development [6]. Moreover, governance is the capacity of the government to steer society [7]. Nonetheless, to avoid absolutism and self-steering capacity of the appointed/elected leaders, the modern perspective of governance requires peoples' participation in decision making process. The conceptualization of governance in a modern expression stipulates citizens' involvement in public decision making. This makes governance a participatory task by both the ruler and the ruled. The participation of every citizen in allocating and managing public resources defines the modern approach of governance across the globe. According to World Bank, governance implies the management of social, political and economic affairs for sustainable development. The World Bank acknowledged three fundamental elements of governance which include the nature of political regime; the strength and ability of the governments to effectively formulate, implement and discharge responsibilities; and the way and manner the regime in power manage the social and economic resources for development [8]. Therefore, governance entails institutional environment in which individual citizen and the political actors interact and participate in the public decision making. It requires the management of public affairs in a transparent, inclusive, participatory, responsive and accountable manners. Allocating resources and judicious use of these resources for development purpose becomes sacrosanct [9]. Hence, it can be argued that governance articulates and accommodates both the formal and informal actors in public decision making. This is to facilitate equal participation in a more inclusive, transparent and accountable management of public resources guided by the rule of law.

In line with the above, the digital revolution which provides transformation in all human societies delineates the concept of governance from primordial model to a modern perspective which indulges the application of information communication technologies (ICTs) in public decision making. e-Governance as a concept emerged at the inception of 21st century in the management of public sector. There is a paradigm shift from traditionalism to modernism in public administration. The emergence of e-governance therefore radicalized the nature of doing governmental businesses around the world. This opportunity paves way for a new path in conducting and managing public affairs, and this introduced e-services in public sector. Thus, e-governance has been acknowledged as capable of increasing the impact of government on the people [2]. e-Governance implies political and civil operation of government using information and communication technologies (ICTs) by which both the government and citizens interact. It is a strategy employed by the government through the use of ICTs with the aimed of encouraging citizens to participate in governance and make the government more transparent and accountable to the general citizenry [10]. e-Governance entails the use of web-based internet application to interact with citizens, employees, other government agencies, associate or business partners. It encourages participation of every citizen in the government business through technological platform [11]. It has been further argued that "the application of information communication technology (ICT) by the government to enhance accountability, create awareness and ensures transparency in the management of governmental business". It further explained that e-governance can be recognized as a political tool employed by government to promote public oriented services [12]. Therefore, it can be acknowledged from the above view that e-governance appears to be a paradigm shift from traditional model of carrying

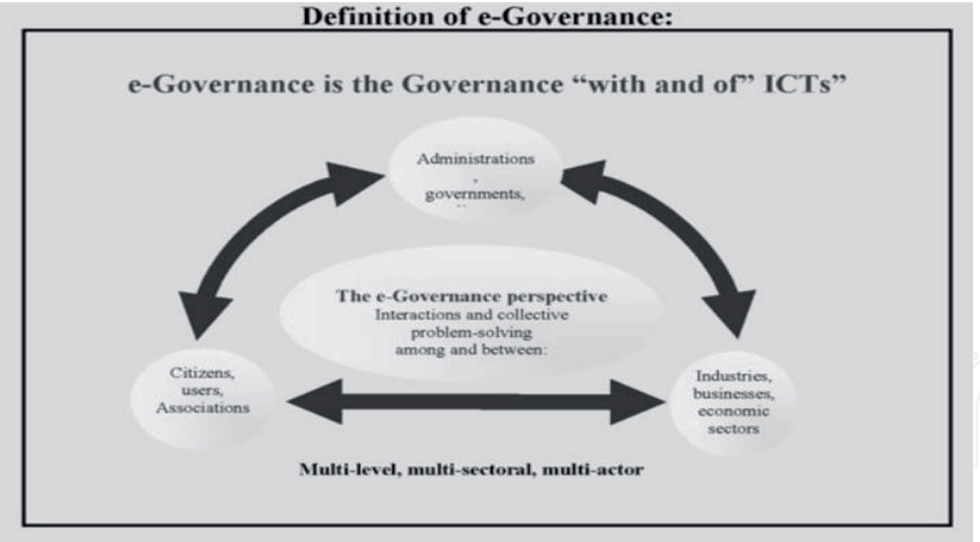

Figure 1.
Definition of e-governance. Source: Misuraca [6].

out governmental businesses which emphasizes compliance with the hierarchical chain of command to the application of internet that allowed the citizens to source for information on government services at their own convenience time which does not necessarily need physical presence in government offices. The primary focus of e-governance is to ensure that citizens have access to government services without direct contact with the public official. The service often delivered through government internet platform. It is believed that the use of internet will reduce the negative impression toward public officials that have been denounced as corrupt. The government websites provide a landscape for the citizens to interact with the government and receive feedback regarding the services provided by the government. In this context, e-governance has the potential to minimize corrupt practices in government establishment [13]. Thus, it can be argued that the major single focus of every e-governance project is to reduce corruption in the management of public affairs across the world.

Many governments around the world have chosen the path of e-governance to manage all government departments and agencies (**Figure 1**). This requires all activities and services provided by the government to be available online such as income tax, customs, property tax and sales tax. The government services are delivered through online platform to the citizenry. e-Governance often necessitates the centralization of data to improve audit and analysis. The inability of the public official to follow online procedures in the conduct of government businesses usually leads to exposure of such act. The citizen complains can also be recounted through e-platform created by government which often requires feedback from the appropriate authority. This environment may facilitate successive strategy to expose corrupt civil servants within the government agencies [11].

3. e-Governance in Africa

In the world over, governments have supported the use of electronic means to provide cost effective services as well as improving the way and manner in which government businesses are carried out. As a result of global acceptance of this strategy, Africa has initiated policies, mechanism and programs toward ensuring effective implementation of e-governance in the region. e-Governance has been one of the key strategies to strengthening democratic governance and as an important

instrument in achieving developmental agenda in Africa. The realization and implementation of e-governance has penetrated the social and political space in the region. This makes it possible for all the stakeholders to participate in governance processes. Moreover, the intra-governmental communication provided as a result of the implementation of e-governance makes it easier to reduce the cost of service and also provides wider reach to the general citizens [14]. Among the several strategies for the actualization of e-governance is the creation of websites, linking the citizens with the numerous services provided by the government – Federal, State and Local. The creation of websites therefore becomes interactive space where the citizens and the government can share their views regarding the activities of government while receiving feedbacks on the same platform. Some of the services available to the citizens range from birth certificate, identity card, voter's registration, payment of tenement rate, taxes and levies etc. One of the countries that showcased e-governance capacity in the management of public is South Africa government. The web provides detail information about the government's services. The South African government offers services within the following spectrum: services for the citizens; services for organization; and services for foreign nationals. The services to the citizens revolves around information concerning youth, education and training, retirement and old age, birth, social benefits, relationship, living with disability, parenting, death, citizenship, sports and recreation, law, transport among others. Services implying organizations include import and export, health and safety, labor related issues, business tax, transport, health and safety at work place, intellectual property among others. Information related to foreign national include immigration and working in South Africa. Similar features are also found in Kenya where the issues related to e-civil service, e-business, e-citizenship, e-education, e-taxes and revenue among several other categories [15]. A comparable features are found in Nigeria where activities such as tourism, drug administration, company registration, immigration, tax, investment, driver's license, education, health, housing projects, corruption reporting, national identity management are embedded in government portal. Thus, it can be deduced that e-governance has facilitates citizen's participation as well as reducing cumbersome nature of traditional mode of governance in Africa. The table and figures below reveals the population of internet users and the level of penetration as compared to the rest of the world.

4. Data interpretation and discussion

From the above, **Figure 2** reveals that Asia region constitutes 50.4% of the world internet users, it further shows that Europe has 16.5%. The data also found that Africa has 10.9%, Latin America and Caribbean 10.1%, North America 7.5%, Middle East 3.9% while Oceania and Australia constitutes 0.7%. In this context, Asia has the

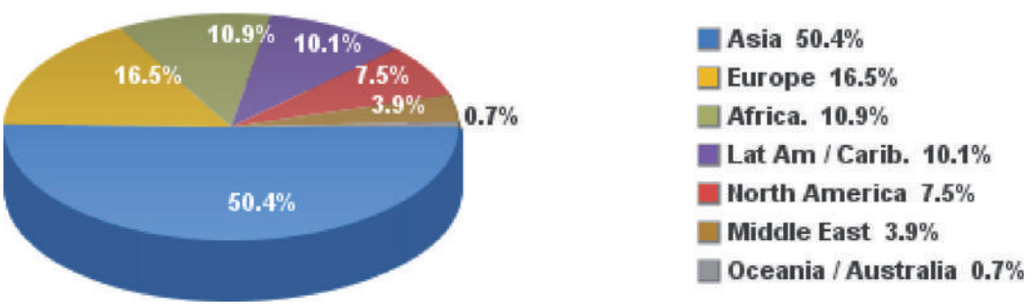

Figure 2.
Internet users in the world by region as at March 2019.

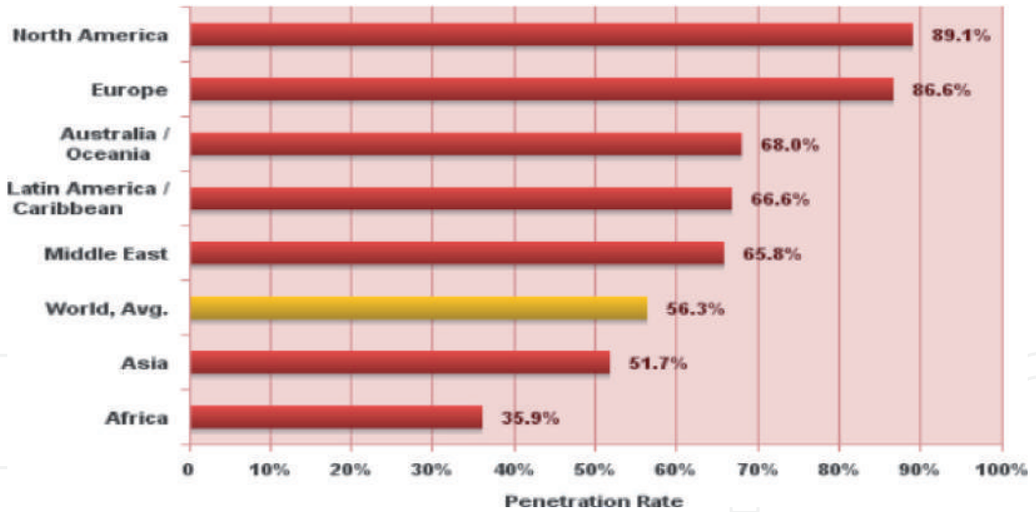

Figure 3.
Internet world penetration rates by geographic regions as at March 2019.

largest number of internet users across the world, followed by Europe. The implication of this as related to e-governance is that the more accessible internet is, the more the people interact with the government on electronic platforms. In **Figure 3**, the data shows internet world penetration rates by geographic regions. The data found that North America 89.1% which constitutes the highest level of penetration globally. This is followed by Europe which has 86.6%. Australia and Oceania has 68.0% while Latin America and Caribbean has 66.8%. The Middle East constitutes 65.8% while the world average is equated to 56.3%. Asia has 51.7% while Africa has 35.9% which is considered as the lowest rate when compared with other regions.

Table 1 shows the Internet Users Statistics for Africa as at March 2019. The table revealed all the countries in Africa with the divergence population, number of

Africa	Population (2019 Est.)	Internet users 31-Dec-2000	Internet users 31-Mar-2019	Penetration (% population)	Internet growth % 2000–2019
Algeria	42,679,018	50,000	21,000,000	49.2	41,900
Angola	31,787,566	30,000	7,078,067	22.3	23.493
Benin	11,801,595	15,000	3,801,758	32.2	25.245
Botswana	2,374,636	15,000	923,528	38.9	6057
Burkina Faso	20,321,560	10,000	3,704,265	18.2	36,942
Burundi	11, 575,964	3000	617,116	5.3	20,470
Cabo Verde	560,349	8000	265,972	47.5	3225
Cameroon	25,312,993	20,000	6,128,422	24.2	30,542
Central African Rep	4,825,711	1500	256,432	5.3	16,995
Chad	15,814,345	1000	768,274	4.9	76,727
Comoros	850,910	1500	130,578	15.3	8605
Congo	5,542,197	500	650,000	11.7	129,900
Congo Dem Rep	86,727,573	500	5,137,271	5.9	1,027,354
Cote d'Ivoire	25,531,083	40,000	6,318,355	25.6	16.246

Africa	Population (2019 Est.)	Internet users 31-Dec-2000	Internet users 31-Mar-2019	Penetration (% population)	Internet growth % 2000–2019
Djibouti	985,690	1400	180,000	18.3	12,757
Egypt	101,168,745	450,000	49,231,493	48.7	10,840
Equatorial Guinea	1,360,104	500	312,704	23.0	62,441
Eritrea	5,309,659	5000	71,000	1.3	1320
Ethiopia	110,135,636	10,000	16,437,811	14.9	164,270
Gabon	2,109,099	15,000	985,492	46.7	6470
Gambia	2,228,075	4000	392,277	17.6	9707
Ghana	30,096,970	30,000	10,110,0001	33.6	33,600
Guinea	13,398,180	8000	1,602,485	12.0	19,931
Guinea-Bissau	1,953,723	1500	120,000	6.1	7900
Kenya	52,214,791	200,000	43,329,434	83.0	21,564
Lesotho	2,292,682	4000	627,860	27.4	15,596
Liberia	4,977,720	500	4,028,418	80.9	805,583
Libya	6,569,864	10,000	3,800,000	57.8	37,900
Madagascar	26,969,642	30,000	1,900,000	7.0	6233
Malawi	19,718,743	15,000	1,828,503	9.3	12,090
Mali	19,689,140	18,800	12,480,176	63.4	66,283
Mauritania	4,661,149	5000	810,000	17.4	16,100
Mauritius	1,271,368	87,000	803,896	63.2	824
Mayotte (FR)	266,380	N/A	107,940	40.5	N/A
Morocco	36,635,156	100,000	22,567,154	61.6	22,467
Mozambique	31,408,823	30,000	5,279,135	16.8	17,497
Namibia	2,641,996	30,000	797,027	30.2	2557
Niger	23,176,691	5000	951,548	4.1	18,931
Nigeria	200,962,417	200,000	111,632,516	55.5	55,716
Reunion (ER)	889,918	130,000	480,000	53.9	269
Rwanda	12,794,412	5000	3,724,678	29.1	74,393
Saint Helena (UK)	4096	N/A	2200	53.7	N/A
Sao Tome & Principe	213,379	6500	57,875	27.1	790
Senegal	16,743,859	40,000	9,749,527	58.2	24,274
Seychelles	95,702	6000	67,119	70.1	1018
Sierra Leone	7,883,123	5000	902,462	11.4	17,949
Somalia	15,636,171	200	1,200,000	7.7	599,900
South Africa	58,065,097	2,400,000	31,185,634	53.7	1199
South Sudan	13,263,184	N/A	2,229,963	16.8	N/A
Sudan	42,514,094	30,000	11,816,570	27.8	39,288
Swaziland	1,415,414	10,000	446,051	31.5	4360

Africa	Population (2019 Est.)	Internet users 31-Dec-2000	Internet users 31-Mar-2019	Penetration (% population)	Internet growth % 2000–2019
Tanzania	60,913,557	115,000	23,000,000	37.8	19,900
Togo	8,186,384	100,000	899,956	11.0	800
Tunisia	11,783,168	100,000	7,898,534	67.0	7798
Uganda	45,711,874	40,000	19,000,000	41.6	47,400
Western Sahara	582,478	N/A	28,000	4.8	N/A
Zambia	18,137,369	20,000	7,248,773	40.0	36,144
Zimbabwe	17,297,495	50,000	6,796,314	39.3	13,492
Total Africa	1320,038,716	4,514,400	474,120,563	35.9	10,402
Rest of World	6,433,444,493	83.0	3,872,441,290	60.2	89.1
World Total	7,753,483,209	100%	4,346,561,853	56.1	100.0

Source: The data was adapted from Internet World Stats. Available at https://www.internetworldstats.com/stats1.htm

Table 1.
Internet users statistics for Africa as at March 2019.

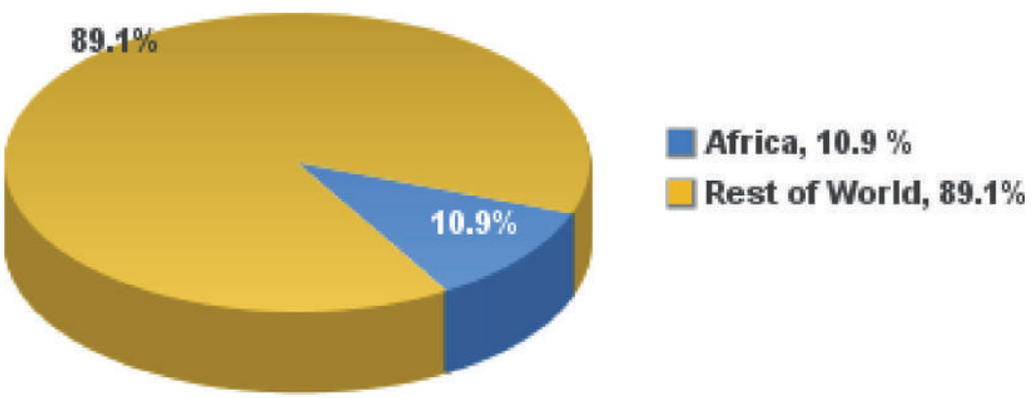

Figure 4.
Internet users in Africa as at March 2019.

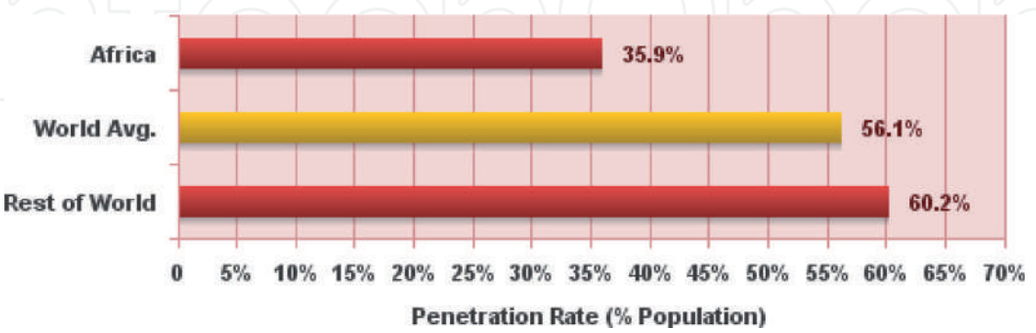

Figure 5.
Penetration rate in Africa as compared to the rest of the world as at March 2019.

internet users, level of penetration and internet growth. In **Figure 4**, the data reveals internet users in Africa as at March 2019. It shows that Africa has 10.9% while the rest of the world constitutes 89.1%. In **Figure 5**, it shows the level of penetration rate in Africa compared to the rest of the world as at March 2019. The data reveals that Africa has 35.9% while world average constitutes 56.1%. The data further shows that

60.2% constitutes the rest of the world. This indicates that, there is a need to reduce the cost of access to digital technology in order to make it affordable for the wider segment of the population. In all, it is acknowledged that Africa has lagged behind in the implementation of digital technology, as indicates in the above data, many African nations have not fully implemented e-governance in managing public affairs. Even though some of these African nations have continually promote the use of ICTs in major government activities, it is believed that the affordability of digital technology will encourage the citizens to employ these platforms to interact more with the government especially regarding governance and anti-corruption campaign.

5. Corruption in Nigerian public sector

Corruption is the abuse of public office for personal gain. Corruption may occur at any levels of government – local, state and national. It can also manifest at the legislative, executive and judicial arms of governments. By and large, corruption exists in every sphere of life, be it public or private establishments. Irrespective of where it occurs, it tends to have a mammoth impact in the general lives of the citizenry especially on the provision of the basic services [16]. Before the introduction of e-governance system, a vast number Nigerian public employees at the local, state and federal levels acknowledged to be terrifically corrupt. The employees in the public sector are recognized to be smart in inflating government contracts and procurements; the system was moribund with ghost worker syndrome in which the names of non-existing public officials were used to pay fraudulent salaries. The committers of such offense initiated a system that bypass banking measure in the payment of salary. In such an environment, they pay public personnel by cash through their ministries cashiers. A huge amount of funds was diverted to the pocket of perpetrators through this channel. Several regimes have contended with this challenge through the inauguration of special staff audit committees, the committee introduced "Table Payment" which requires physical presence of staff. However, this measure was unable to rule out the corrupt elements in the public

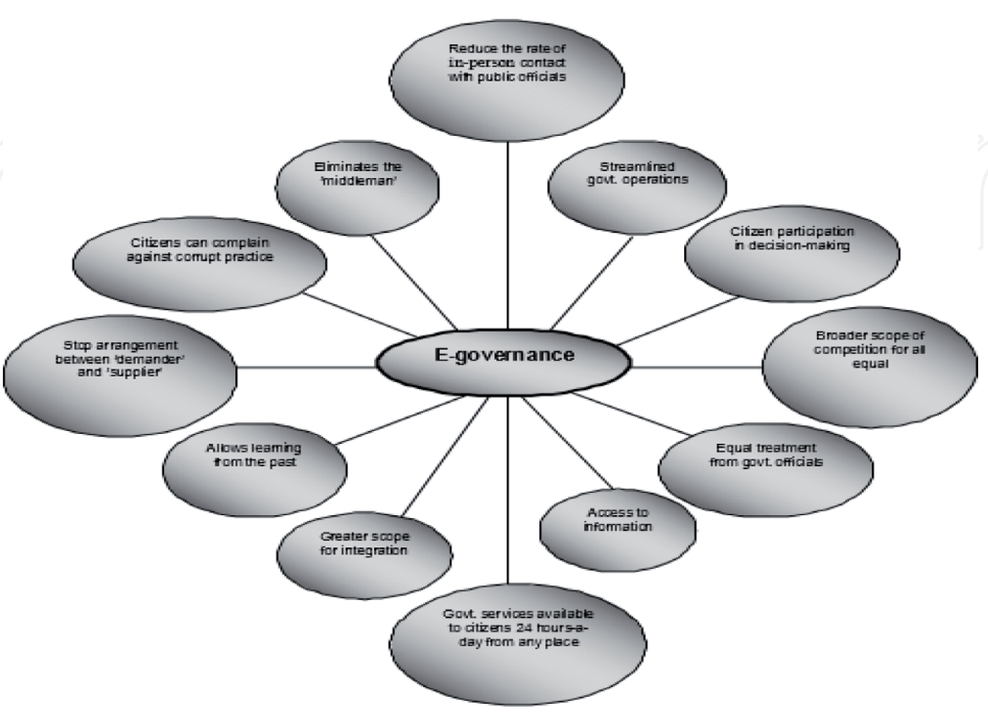

Figure 6.
How e-Governance can prevent corruption. Source: Iqbal and Seo [10].

sector [13]. Consequently, the diversion of government revenue and foreign aid into the individual personal purse within the public sector has contributed to the deprivation of some basic social services. It has been estimated that approximately 400 billion was stolen from Nigerian public treasury from 1960 to 1999, between 2005 and 2004, the sum of $182 billion was diverted from the public accounts via illegitimate financial flows. The stolen common wealth meant for educational development, health sector and general infrastructural development was diverted by public office holders for personal aggrandizement [17]. The culture of corruption entrenched in Nigerian public sector has a great impact in the life of the citizens. Its effect on infrastructural development has been acknowledged and its corollary has being experienced by the citizens in their daily engagement (**Figure 6**).

In **Figures 7** and **8**, these platforms showcase the electronic model designed to mitigate corruption in Nigeria. On these platforms, several activities are embedded,

Figure 7.
Independent corrupt practices and other related offenses commission.

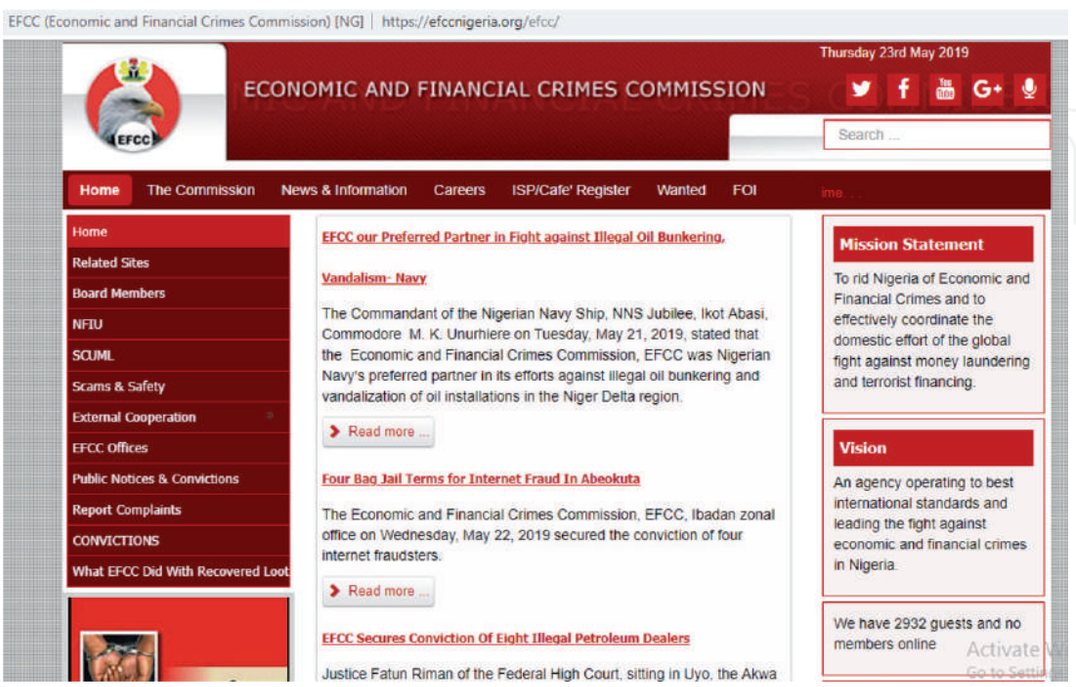

Figure 8.
Economic and financial crimes commission.

ranging from corruption reporting, whistleblower channel, number of people prosecuted for corruption, complaint and observation of the citizens against the mandate of anti-corruption institutions, petition among other related activities. These platforms have encouraged the citizens to report several cases of corruption which the anti-corruption institutions have investigated in recent time. Without physical presence of the citizens, corrupt practices can be reported on the website of the Independent Corrupt Practices and Other Related Offenses Commission (ICPC) and Economic and Financial Crimes Commission (EFCC). This effort has yielded an expected outcome following the adoption of e-governance in combatting corruption in Nigerian domain. Therefore, anti-corruption war is considered as government and citizens' struggle, it is believed that if government co-opted the citizens in fighting corruption, corruption will be mitigated to a barest minimum level in the country.

6. e-Governance as a potent weapon for anti-corruption war in Nigeria

The nexus between e-governance and anti-corruption war has been globally pronounced by a number of scholars [12, 18–21]. Information communication technology is considered as a fundamental instrument that can be employed to tame the ugly trend of corruption. ICT is capable of mitigating corruption by promoting good governance, monitoring the activities of government and the governed. The use of electronic measure in the daily governmental business has a great impact in the fight against corruption among other measures put in place by the government in many developing nations of the world [1]. Several efforts have been put forward to prevent corruption by different regimes. The creation of Independent Corrupt Practices Commission (ICPC), Economic and Financial Crimes Commission (EFCC) and Code of Conduct Bureau among others. Despite the creation of different institutions to checkmate the spreading wave of corruption in both the public and private sector in the country, it appears that these measures were not absolutely capable of reducing corrupt practices in Nigerian society. The ineptitude of the above-mentioned measures triggered the development of e-governance scheme which was strengthened to foster transparency in the conduct of public affairs. The implementation of e-governance approach was made possible with the adoption of Information Communication technologies (ICTs) revolution. The implementation process was initiated as a pilot scheme initiated in some ministries and federal parastatals. Following this event, other levels of governments began to adopt this policy to tackle the high level of corruption in the country. The adoption of this policy aimed at block the manifold sources by which public officials employed in siphoning public funds such as double payment of contracts and ghost workers. A huge amount of public funds has been saved by the three tiers of government due to implementation of e-governance project. The philosophy behind this policy is to reduce corruption and increase the level of transparency and accountability in the public and private sectors [22]. It is a by-product of ICT, which is an efficient and effective strategy to tackle corruption idiosyncrasy. Even though e-governance is not the first and last method to curb corruption in the public sector, it is being practiced very efficiently in the developed countries and in a few developing countries as well. In general, developing countries have succeeded much in implementing e-governance. Their efforts to apply the tools and strategies have been discernible since the last couple of decades [4]. The services delivered through electronic means such as tax payment, rate, license are capable of mitigating human error and corruption in the public arena. In an environment where public administration is digitalized, physical contact which has the potential of promoting corrupt practices is mitigated. e-Governance serves the purpose of bringing transparency,

accountability and openness to the public service [3]. Nigeria has embarked on numerous strategies in reducing corruption especially through e-governance within the public sector. The public sector reform includes Treasury Single Account (TSA), Biometric Time and Attendance, Integrated Payroll and Personnel Information System (IPPIS), Prepaid Meter. Other initiatives include e-passport, online registration of Joint Admission Matriculation Board (JAMB) by candidates, introduction of computer based examination to reduce exam malpractice, the use of card reader during election, e-reporting of human rights abuse, monthly publishing of local and state governments allocation by the ministry of finance which allows citizens to be aware of how the government use their public resources [22]. According to Davies and Fumega, there are eight kinds of ICT mechanism that can be used to prevent corruption, these include the following:

i. Online services: Platforms offer public self-services that citizens can explore

ii. Transparency portals: These platforms provide periodic government publication of important documents which are accessible to the citizens online;

iii. Open data portals: These platforms offer free access to data sets in machine-readable formats.

iv. Crowd sourced reporting: This entails the citizens to report grievances regarding the activities of government;

v. Online corruption reporting: The platforms that provide opportunity for citizens to report cases;

vi. Online right-to-information requests: platforms that allow citizens to file right-to-information requests.

vii. Issue reporting: platforms that allow citizens to report problems with public services

viii. Service automation: platforms that replace discretionary decision-making by public officials with auditable software processes [23].

In Nigeria, there are policies implemented by the government to curb corruption in the public domain, some of these policies are discussed below:

7. Treasury single accounts (TSA)

The TSA policy was initiated as part of Economic Reform and Governance program in 2004 by the Federal government in Nigeria. TSA is an integrated national bank account in which all the federal government ministries, departments and agencies (MDAs) remit daily government revenue. The implementation of this policy by the national government aimed to block all leakages in Nigerian revenue generating agencies as well as to guarantee judicious use of government resources for the benefit of the citizens. The TSA is one of the components of public financial management (PFM) reforms which was under the third pillar of National Strategy for public service reforms geared toward achieving vision 20:20:20 aimed to address the challenge of ineffective and inefficient cash management in the country. The implementation of this policy necessitates adoption of e-payment system for every

single financial transaction, and it came into full force in January 2009. The adoption of this policy aimed at ensuring efficiency, effectiveness, transparency, openness and accountability in the management of the country's financial resources. Although, before the implementation of TSA, the country was moribund with challenge of monitoring all government accounts by the Office of the Accountant General of the Federation (AOGF). The TSA was guided by three fundamental principles: the unification and synchronization of government treasury accounts; only the chief financial agents of the government are saddled with the oversight responsibility in managing cash resources of the government; and there should be comprehensive coverage of both the budgetary and extra-budgetary as well as consolidation government's cash resources [24].

8. Cashless policy

In 2012, the Central Bank of Nigeria (CBN) inaugurated the implementation of cashless policy, projected to eliminate the physical cash flow in the national economy so as to promote e-transaction. The policy was first implemented in Lagos in January 2012. The policy is aimed to reduce the primary cost of banking services; promote modernization and development of Nigeria's payment system in accordance with vision 20:20 goal to be among the top 20 economies by the year 20:20; reducing high cash usage outside the formal sector and therefore provide opportunity for effective management of inflation to promote economic growth; reducing the risk of high handling of cash which encourages robberies and related crimes; and to mitigate systemic leakage that promote corruption. The fundamental objective of this policy is to encourage cashless economy. The cashless economy inculcates the promotion of payment without the involvement of physical cash. It does not totally exclude the use of physical cash from the economy but an economy where the use of cash is reduced to a bearable minimum level. In such a cashless environment, electronic based payments dominate the economy with the use of credit cards or mobile or bank transfer. Some of the components of cashless policy may incorporate e-exchange, e-money, e-brokering, e-finance among others. The primary measures for the cashless policy in Nigeria imply:

i. Daily cumulative cash limit: N500, 000 and N3 million on free cash withdrawals and lodgments by individual and corporate customers respectively. These are upward reviews from the daily cumulative limits of N150, 000 and N1 million set in January, 2012.

ii. Processing fees for withdrawals above limit: 3% for individual and 5% for corporate. These are downward reviews from the respective 10% and 20% fees set in January, 2012.

iii. Processing fees for lodgments above limit: 2% for individual and 3% for corporate. These are downward reviews from the respective 10% and 20% fees set in January, 2012.

iv. Exemptions from processing fees: this applies to accounts operated by ministries, departments and agencies (MDAs) of the federal and state governments, solely for the purpose of revenue collections. Exemptions also extended to embassies, diplomatic missions and multi-lateral and aid-donor agencies, as well as micro finance banks.

The major goal of this policy is to ensure that the larger percentage of Nigerian populace utilizes electronic platform in their daily transaction. Several measures put in place to accomplish the cashless policy include the following methods:

i. Automated Teller Machine (ATM). ATM can be used for the payment of bill, deposit cash, funds transfer, recharge airtime for mobile phone

ii. Internet banking: This can be employed to make instant balance enquiry, funds transfer, payment of application fees and utility bills. Some of the banks require the customers to use token in order to guarantee security and safeguard the account against fraudsters.

iii. Point-of-Sale (POS) Terminals: This can be used to make payment of any transaction made by the customers.

iv. Electronic Transfer: This can be employed to transfer funds electronically from the customer's account to other sources or destinations [25].

9. The government integrated financial management information system (GIFMIS)

This is an integral component of the ERGP initiative targeted toward tackling corruption through information technology. It was implemented to provide support to public resource management by employing integrated and automated mechanism to ensure effective and efficient economic system. The implementation of this policy is aimed to enhance transparency, accountability and cost effective public service delivery. The primary objective of the GIFMIS is to key into computerized financial information system for the federal government to increase:

i. Federal government capacity to effectively control and monitor the general expenditure and receipts of MDAs

ii. The capability to understand the general costs of collections of activities

iii. The ability to exhibit transparency and accountability to the public and partners

iv. The ability to access information on government's economic performance and cash flow

v. Medium term planning through a medium term expenditure framework (MTEF).

vi. Internal controls to identify and prevent possible fraudulent actions

vii. The access to information on financial operation

Ultimately, the focus of the GIFMIS is to support and improve the federal government public financial management performance. The financial management obligations constitutes the overall financial management cycle of government which includes budget preparation, budget execution and financial reporting. GIFMIS aimed to be used in all areas of government budget preparation, execution

and general management of financial resources. Additionally, GIFMIS enables effective revenue collection through integrated system of revenue collection especially in some agencies like Federal Inland Revenue Service (FIRS), Customs, Nigerian National Petroleum Corporation (NNPC) and providing effective revenue remittance and transfer to the TSA [24].

10. Conclusion

This chapter has examined e-governance as an effective mechanism in tackling corruption in Nigeria. Although, there have been several efforts by the past political regimes in fighting corruption in the public sector, it appears that some of the efforts put in place were able to yield minimal outcomes. The recent initiative regarding application of information communication technologies (ICTs) in the general management of public affairs has been considered as effective mechanism to complement the effort in curbing corrupt practices in the public sector. This chapter demonstrates that e-governance as a modern technological tool is capable of reducing high level of corruption in the public sector in the country. The current initiative to reduce the level of corruption in Nigeria necessitates the implementation of e-governance strategy which revolves around the Treasury Single Account (TSA), internet banking, limitation in cash withdrawal, the Government Integrated Financial Management Information System, cashless policy among others. These numerous strategies have been utilized to minimize corrupt practices in Nigeria. Some of these strategies have provided opportunity to prevent ghost workers from continuous existence in Nigerian public sector. Although, the adoption of these measures has been producing positive outcomes, however, there are numerous challenges affecting the effective functioning of e-governance especially among the citizens. These challenges range from social arena where there is low literacy level, poor basic education, lack of access to internet by rural populace, lack of feedback, low level of technological adaptation, different languages, shortage of skills, poor IT literacy as well as political aspects that revolves around lack of cyber laws, poor reform agenda, low budget allocation among others. To make the use of ICTs more effective in the public sector, the government needs to ensure training and retraining of its staff in handling ICTs for effective service delivery, provide affordable market for internet users, re-orientate the local community of its benefits and provide enabling environment for effective implementation of e-governance at the local, state and national levels.

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Chapter

Crowdsourcing Strategy of Information Society

Tetsuro Saisho

Abstract

In the modern information society, it has become possible to develop new business models that utilize ICT (information and communication technology) in various industrial fields, industries, and business sizes and types. Crowdsourcing is attracting attention as a new business model in this society. In crowdsourcing, business persons are using Internet websites (crowdsourcing platforms) to generate orders for new business activities, such as "order work to an individual" and "require job orders". In addition, through the utilization of crowdsourcing, the lifestyle of workers is also changing with the provision of new job opportunities. In other words, crowdsourcing offers a new working style to a wide range of people. Thus, the spread of crowdsourcing has created new options for how individuals work and live. In the modern information society, crowdsourcing is a new business model that links a business person (orderer) and a worker (contractor) through a website. In this paper, we outline this new business model for the information society, and discuss the current situation of crowdsourcing, which looks to further influence lifestyle changes in the future. We propose a new business model using ICT, and consider the current situation and potentialities of crowdsourcing, which has elements that may result in major changes in the nature of employment in the future.

Keywords: information society, crowdsourcing, matching business, strategic positioning

1. Introduction

In the modern information society, it has become possible to develop new business models that utilize ICT (information and communication technology) in various industrial fields, industries, and business sizes and types.

Business development using ICT involves more than the typical industries from the past. In the creation of new businesses, it can be applied to a wide range of fields including SMEs (small and medium enterprises) and VEs (venture enterprises) [1].

For example, in the manufacturing industry, an inventory management system is introduced to manage product inventory and determine optimal inventory numbers; while, in the distribution industry, a sales management system is introduced to receive orders and deliver products.

With the introduction of ICT into other fields, there is support for design and drafting by CAD (computer aided design). In addition, the introduction of CIM (computer integrated manufacturing) at production sites can manage the entire range of production activities. With the introduction of CALS (commerce at light speed) in the product life cycle, information, from product design and manufacture

to settlement, is shared between the customer side and sales side. Further, companies in the finance, education, and service industries, for example, are developing new businesses using cutting-edge ICT.

With the advent of the information society, crowdsourcing is attracting attention as one of the new business models that utilize ICT. Crowdsourcing uses a crowdsourcing platform, typically a web site on the Internet, to allow business persons to place orders for an unspecified number of individuals and recruit contractors. In this way, crowdsourcing is creating new forms of work ordering and employment.

In sum, in the modern information society, crowdsourcing is a new business model that links a business person (orderer) and a worker (contractor) through a website. In this paper, we will outline this new business model for the information society, and discuss the current state of crowdsourcing, which has elements that promise major changes in the nature of employment and lifestyle in the future.

2. Information society and crowdsourcing

2.1 What is crowdsourcing?

Crowdsourcing is a coined word meaning "outsourcing works to an unspecified person (Crowd)" [2]. As such, it is "a mechanism to access an unspecified number of individuals or companies via the Internet to procure the necessary human resources" (**Figure 1**) [3].

In other words, through crowdsourcing, business persons use ICT, and through crowdsourcing platforms (websites) of crowdsourcing site business person (orderer), to a large number of general unspecified people (worker, contractor) it is the business consignment (outsourcing) of procuring workers from the outside by conducting business orders of the company and recruiting of contractors in the business.

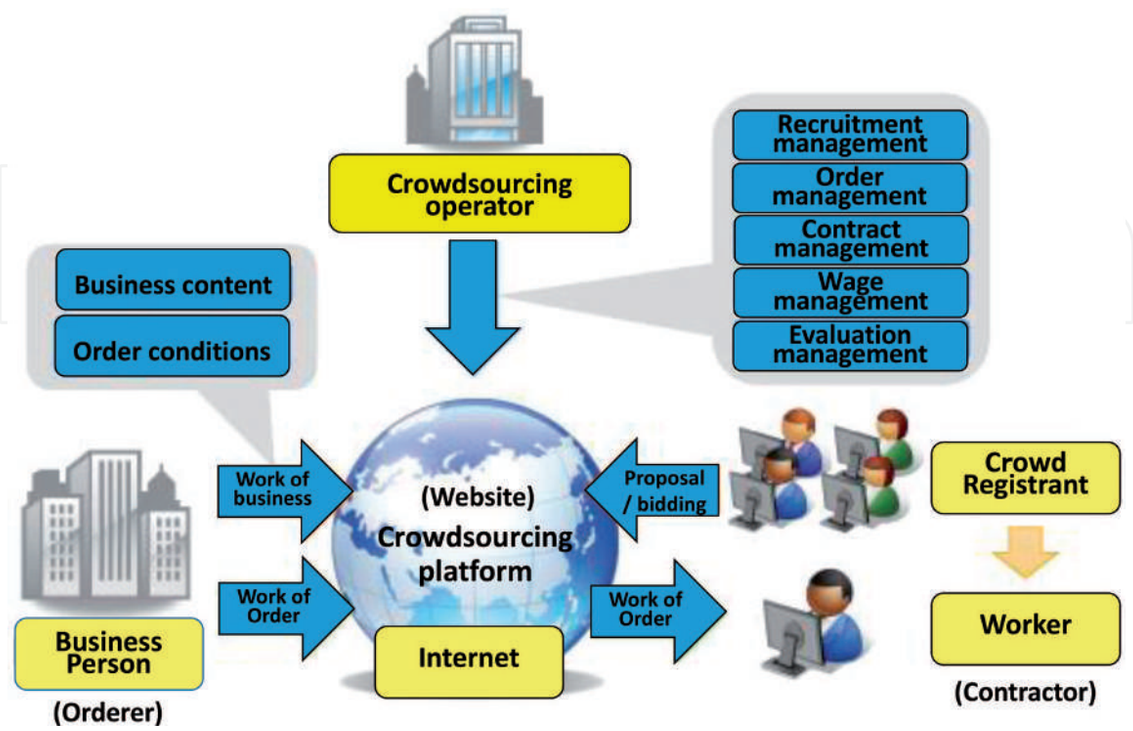

Figure 1.
Crowdsourcing participants and structures. Source: created by author from Ministry of Internal Affairs and Communications (MIAC) (2014), impact on society brought about by rapid evolution of ICT, "Information communication white paper 2014 edition", MIAC.

The respective crowdsourcing relationships between the business person (orderer) and worker (contractor), the crowdsourcing platform of the website (broker), and the flow of business orders, are as follows.

1. The business person uses crowdsourcing in operations where it is difficult for the company alone to respond to a given need, or in operations where external ordering is most efficient.

2. The workers cover a wide range, from individuals without special skills to specialists with well-defined expertise.

3. The business person inputs the work content and order acceptance conditions (work period, work time limit, remuneration, salary, fee, etc.) to the crowdsourcing platform of the website.

4. The worker confirms the work content in the crowdsourcing platform and applies for the specific work.

5. For each task, matching between the business operator and worker is performed, the worker is determined, and a business contract is concluded.

6. The worker is paid a fee after delivering deliverables to the business person.

In the crowdsourcing site business person, the crowdsourcing platform (website) carries out management operations such as defining work content and work location, recruitment management (such as compensation), ordering management, contract management, payment management, and performance and evaluation management.

Crowdsourcing contractors (workers) do not have to work at the business person's facility or at a location near the business person. In other words, workers can work anywhere with Internet access: urban areas, rural areas, sparsely populated areas, islands, overseas, etc. Workers can perform work anytime, anywhere, regardless of the business person's location.

In a 2014 survey involving Freelancers Union, a group for freelancers (workers) in the United States, and Elance-oDesk, a crowdsourcing company, the following elements were identified: "(1) independent contractor: work for a specific project or contract; those who hold a contract", "(2) moonlighter: those who hold a side job from late at night to early morning while holding a regular job", "(3) diversified worker: those who have multiple income sources", "(4) temporary worker: specified by non-regular employment; those who work with their employers", "(5) business owner: have five or fewer employees and work themselves as workers and businesses" [4–6].

The percentage of each element type was: (1) independent contractor (40%), (2) moonlighter (27%), (3) diversified worker (18%), (4) temporary worker (10%), (5) business owner (5%). There are many ratios of independent contractor and moonlighter.

2.2 Crowdsourcing and cloud computing

In recent years, one of the information system configurations that has attracted attention in organizations such as companies is cloud computing, which may on the surface appear similar to crowdsourcing, but is in fact fundamentally different'.

Crowdsourcing outsources work to unspecified people through the Internet; whereas, in cloud computing, computer resources such as software and data

related to computer management and use are employed as needed, by means of the Internet [7, 8].

Cloud computing can be roughly divided into (1) SaaS (Software as a Service), (2) PaaS (Platform as a Service), and (3) IaaS (Infrastructure as a Service), according to the types of functions and resources to be provided.

1. SaaS is an Internet-based service that enables remote control of application software having a specific function. SaaS services include online storage and office software that can be used with a web browser.

2. PaaS is a service that enables remote control of the software execution environment via the Internet. PaaS service allows a subscriber to remotely operate an environment in which an OS or middleware has been installed on a computer.

3. IaaS enables remote control of the virtualized computer itself via the Internet. In IaaS service, users prepare, install, and operate all software, such as the OS.

Thus, the "cloud" in cloud computing is a symbol representing a cloud on the other side of a network in a system configuration diagram; whereas, the "crowd" in crowdsourcing refers to an unspecified crowd of people meeting on the Internet platform. "Cloud sourcing", meanwhile, is a specific form of outsourcing in which companies, etc. outsource operations to external vendors and workers.

2.3 Business object of crowdsourcing

Through crowdsourcing, one can rapidly secure workers in-house, such as for software development, including "writing of text", "design of logo and illustration", "programming of the Web and application"; as well as pursue recruitment initiatives based on a specific plan. It is possible to procure and process workers from outside the company in a short time and at a low cost; workers, for example, with specialized skills that are difficult to perform, or a group of workers.

In addition, in crowdsourcing, operations are outsourced widely to professionals and non-professionals. Thus, crowdsourcing is more than the outsourcing of highly specialized tasks demanding specialized skills. Crowdsourcing covers a wide range of projects, including the outsourcing of simple tasks such as data entry and information gathering.

Among the typical crowdsourced task categories are: "Explanation", "Graphics", "DTP (Desk Top Publishing)", "Web Design/Coding", "Content Writing", "Editing of Video/Image", "CMS (Content Management System)", "Blog Homepage", "Application Development", "Web Skills", "Middleware", "Smart Phone Site Development", "Software Development Language", "Environment/Framework", "Data Base", "System Development Technique", "Source Code Management", "Incident Management", "Cloud OS (Operating System)", "Social Media", "3D (Three Dimensions) Technology", "Testing/Operation and Support", "Qualification Skills", "Language/Interpretation/Translation", and "Lawyers"; all of which typically involve specialized work or work requiring special skills.

In addition, among the categories requiring no experience in crowdsourcing, or involving comparatively simple work, are: "Writing (Catch Phrase/Copy Writing, Name Recruitment/Naming, Blog Writing, Review, Article/Content Creation, Document Creation, Editing/Proofreading, Sales Copy/Sales Letter, E-book Production, Mail Magazine Agent/DM (Direct Mail) Creation/Other Writing)", "Task/Work (Data Creation/Input, Question/Question/Testing Test, Internal

Job/Light Work, Various Agency/Call, Photo/Video, Data Classification/Categorization, Other Tasks/Work)", "Office Work/Business Support/Survey (Site Operation/Support, Business Support, Interview, Mystery Shopper, Masking Investigation, Inquiry Response, Email Correspondence, Telephone Support, Sorting of Documents, Business Card Arrangement, Bookkeeping Charges, Secretary Behalf, Easy Investigation, such as the work of other support)"; all of which are typically involved in various fields and industries.

2.4 Forms of employment in crowdsourcing

Thus far, in Japan, the main form of employment of human resources has involved a business entity, such as a company, which bears the primary burden of risk, and engages full-time employees through the conclusion of employment contracts between a business person (orderer/enterprise) and a worker (contractor/individual).

In the information society, however, a wide variety of temporary staffing agencies, worker dispatch companies, job placement agencies, business contractors, etc., have emerged, due to changes in the social environment surrounding businesses, changes in individual needs, and changes in personal lifestyles.

Traditionally, depending on the details of the employment contract between the employer and the worker, full-time employees, contract employees, temporary employees, part-time workers, and part-timers (for whom, in each case, the burden of risk in the employment contract rests on the company, intermediary, agent, etc.) are the typical worker profiles.

However, with the introduction of crowdsourcing, business activities are widely outsourced (ordering) to a large number of generally unspecified individuals. Crowdsourcing thus does not typically involve the execution of work after closing an employment contract between a business person and a worker; but rather the execution of work based on a business contract between a business person and the worker (the risk burden is on the individual).

One result is that, for the modern business person, how to effectively utilize the knowledge resources of specialists outside the organization (out-house group) has become one of the sources of competitiveness in business. Businesses must not depend on themselves alone in the creation of new products and services, using only their own resources and technologies (in-house group). Instead, they must establish core competencies in their areas of activity, and differentiate themselves from other companies.

2.5 Crowdsourcing and competitive advantage

Businesses use specialists and special skills contractors outside the organization, while also carrying out simple operations such as "work with no experience", "work with low expertise", "fine work that can be divided", etc.; thereby making effective use of external resources. In other words, it has become necessary for business persons to outsource their work "when it is necessary", "without direct work", and "with little effort", from their own organization.

Therefore, as a result of the arrival of today's information society, the practical use of ICT is a premise of successful business activity. Unlike in the past, it is often necessary for businesses to make effective use of resources outside the organization, not only in the case of large companies that utilize BPO (business process outsourcing) for most of their operations, but also for SMEs and VEs. To establish their competitive advantage, they must often use resources outside the organization as labor options, for tasks beyond their core competencies.

One of the success factors of modern business is how to make the best use of cheap external labor, and to establish a competitive advantage, each of which is facilitated by crowdsourcing.

In addition, using crowdsourcing, the business person obtains advance information on the prospective worker's quality of work, which is disclosed in advance, through the crowdsourcing platform, enabling him/her to order work after a full and detailed evaluation, including dialog if necessary.

3. Crowdsourcing classifications and functions

3.1 Classification of crowdsourcing

Crowdsourcing modalities can be classified in various ways, and as yet no clear delineation has been made. Thus, here, for practical purposes, they have been roughly classified, based on elements such as the work content and compensation assigned in placing an order, into three types: (1) platform, (2) reward, and (3) order [9].

Hereafter, we will discuss crowdsourcing in these terms.

Crowdsourcing organization in the US, crowdsorcing.org, from the work of crowdsourcing platform handling, (a) cloud labor: simple work requiring high-level skills, (b) crowd creativity: leverage creative talents around the world through the internet, (c) crowdfunding: raise funds for new projects and company establishment from a large number of unspecified people, (d) distributed knowledge: collect, build, and share knowledge assets and information, (e) open innovation: use ideas from individuals outside the organization, are classified into five [10].

3.1.1 Platform type

Platform type crowdsourcing is based on the specific forms of crowdsourcing platform that are provided for workers, and is also referred to as the business classification type of crowdsourcing. The platforms can be classified into three types: (a) integrated platform, (b) sector specific platform, and (c) research and development platform.

3.1.1.1 Integrated platform type

In information system development, crowdsourcing work may include things such as "basic design", "detailed design", "programming", "unit test", "connection test", and "system test". Other information system fields include "website creation", "Web design", "EC (Electronic Commerce) site and net shop construction", "application and smart phone development", "hardware design and development", and "project and maintenance, operation management".

In manufacturing, etc. crowdsourcing may for example include "design work", such as designs and patterns plans and layout creation. In addition, in business writing, etc. there is "copy writing" which aims at advertising copy that is easy and interesting for the user to read, and "Web writing", involving the generation of website text.

In the integrated platform type, there is a wide range of work, including "photograph and video shooting", "data input", "questionnaire", "interview and question", "answering machine", "various agents", "check and inspection, investigation", "office work and secretarial", "accounting and finance", and "human resources and payroll", etc.

As described above, in the integrated type, a business person and worker collaborate in the execution of various orders by handling a wide range of work types.

3.1.1.2 Sector specific platform type

In the fields of logos, banners, and illustrations, crowdsourced work may include "logo creation", "banner creation", "illustration creation", and "game illustration creation"; while other printed matter and DTP design fields include work such as "leaflet creation", "business card creation", "brochure creation", "poster creation", and "packing and package design".

The character, icon, and animation fields include work such as "recruitment of character design", "manga and animation production", "icon creation", and "goods production and novelty". In addition, the map, signboard, and infographic fields include work such as "map making and guide map creation", "signboard design", and "infographics". The POP (Point Of Purchase), menu, and seal fields include work such as "seal and label design" and "POP design".

In the sector specific type, there are operations that limit the types of jobs to specific and often specialized fields such as "binding, book design" and "design and production of CD (Compact Disc) and DVD (Digital Versatile Disc) jackets". As described above, the sector specific type is a system in which a business person and a worker receive and place orders of limited operations by handling specialized operations.

3.1.1.3 Research and development platform type

Business persons use crowdsourcing to address a wide range of issues around the world, in order to respond to their own management, and other, challenges. As a worker (specialist in research, engineering, etc.), it is possible to address various issues, regardless of the time or place.

In the research and development (R&D) platform type, when an enterprise does not have an R&D department, or wishes to accelerate R&D, the company can broadcast its technical issues worldwide and make a broad search outside its own technological and developmental capabilities. In R and D type work, not only researchers at universities and research institutes, but also general inventors and researchers at companies, make technical proposals for the tasks on offer.

The R&D platform type improves the speed of solving technical issues in the enterprise, and facilitates the technical proposals of researchers and engineers. As described above, the R&D platform type involves a business person and workers receive and submit a technical proposal by handling the work of problem solution and proposal.

3.1.2 Payment type

In payment type crowdsourcing, a worker receives compensation as an economic reward. The payment types can be classified into four groups: (a) gift payment, (b) point payment, (c) payment-agency payment, and (d) cash payment.

3.1.2.1 Gift payment

The gift payment worker receives a reward as an economic compensation, such as an Amazon gift or an iTunes gift. Amazon gifts can be used to purchase products that are handled by Amazon.com, Amazon.co.jp, Javari.jp, etc. ITunes gifts can also

be used to purchase songs, albums, playlists, audiobooks, music videos and movies in the iTunes Store and the App Store.

3.1.2.2 Point payment

Point payment workers receive, as economic compensation, rewards from various services at points such as PeX Japan (Japan's largest point exchange website), PointExchange Japan (Currently, RealPay), T-POINT Japan (Strategic Comprehensive Alliance, Yahoo! JAPAN, etc.), etc. The points can be used for electronic money, gifts, miles, goods, and various other point types.

3.1.2.3 Payment-agency payment

A payment-agency payment worker receives, as financial compensation, a reward through one of the world's leading payment-agency companies such as Paypal (Singapore), Alipay (China), Pay-easy (Japan), Linepay (Japan), Google pay (US), R pay (Japan), etc. A credit card is required to use the payment-agency method.

3.1.2.4 Cash payment

Cash payment workers receive compensation directly by bank transfer, with cash as financial compensation.

3.1.3 Order payment type

Order payment crowdsourcing is a distinct work order structure. The order types can be classified into four groups: (a) micro task payment (fixed salary), (b) contest competition payment (fixed salary), (c) project payment (fixed salary), and (d) project payment (hourly salary).

3.1.3.1 Micro task payment type (fixed salary)

Micro task payment crowdsourcing consigns small units of work at a low price, such as data entry by workers, or questionnaires, explanatory text creation, and list creation. In this order type, the work content is subdivided, and a supplier is determined for each sub-unit.

3.1.3.2 Contest competition payment (fixed salary)

Contest competition payment crowdsourcing recruits work in a competitive format, such as design, naming, or catch phrase creation, and chooses from among the best. In this order type, a large number of works, ideas, plans, etc., are collected, and the best are selected from among them.

3.1.3.3 Project payment (fixed salary)

In project payment crowdsourcing the supplier is selected in response to a proposal from a worker, for work such as application development or website creation. In this order type, information on the quality of the worker is obtained in advance, and the work is ordered based on judgments of skills, evaluations, comments, etc. In addition, business estimates are solicited and bid for (price, delivery and content, etc.), on the basis of which the supplier is determined.

3.1.3.4 Project payment (hourly salary)

In this order type, crowdsourcing provides time management software for the respective worker's PC, and pays rewards on a time conversion basis for work done. In this case, the worker is paid regardless of whether there are deliverables or not.

3.2 Crowdsourcing features

The relationship between a business person (orderer) and a worker (contractor) in crowdsourcing is typically restricted to exchange via a website (crowdsourcing platform) on the Internet. Crowdsourcing is not a business model that involves work requests to specific regions or individuals, because it is based on work orders for an unspecified number of people or a recruitment of contractors.

With the crowdsourcing system, workers can view and confirm the work content from the projects (work information) provided to the crowdsourcing platform, and then select the work of their choosing, performing it in their own chosen place and time, and with considerable latitude in terms of how much work they choose to do. Then, the worker obtains an "Amazon gift voucher", "iTunes gift", "PeX", "Point Exchange", "T-POINT", "cash", etc., as remuneration for the work.

The crowdsourcing platform (website) thus intervenes between the business person (orderer) and worker (contractor). The platform lists the information, work content, and working conditions, as defined by the business person, and provides them directly and widely to prospective workers.

In addition, the business evaluation of the workers related to the project is performed by the business operator who has placed an order and comments on the crowdsourcing platform. The worker's work history and work contents are screened.

Therefore, we see the emergence of a new kind of business model, wherein the business person can preliminarily evaluate a prospective worker's work quality, select the worker most suitable for the work content and cost, and efficiently place the work order.

Hitherto, in the relationship between a business person (orderer) and worker (contractor), it has been difficult to make such preliminary evaluations before outsourcing the task. However, with the use of crowdsourcing, information about the work quality of the prospective worker (crowdsourcing experienced) can be obtained in advance via the crowdsourcing platform.

The business person can thus place an order for a task, having determined the skills, evaluations, reviews, and the like, of the prospective worker, based on the prior information. Therefore, it is possible to reduce the risk of mismatching based on insufficient preliminary evaluation along conventional lines.

3.3 Typical features of crowdsourcing

The main functions of the crowdsourcing platform are: (1) contact and reporting, (2) business item matching, (3) contract progress and settlement management, (4) business follow-up, (5) business scouting, and (6) administrator management [11]. In each function, matching between a business person and a worker is performed before placing an order for work or recruiting a contractor.

3.3.1 Contact and reporting

In this function, the platform sends an email from the business person to a registered email address, regarding information such as business content and order

acceptance conditions. Also, in the text, information can be distributed quickly and efficiently using a fixed format.

3.3.2 Business item matching

This function allows the worker themself to search for work and apply directly for the desired work content. In addition, when the business person places an order for work, it is possible to quickly search for a worker who wants to receive a work order, and to order the work quickly and efficiently.

3.3.3 Contract progress and settlement management

This function performs progress management and settlement management of the project item after the contract has been concluded between a business person (orderer) and worker (contractor). In addition, the payment of compensation to workers can be managed quickly and efficiently through the intermediation of the crowdsourcing platform.

3.3.4 Business follow-up

This function allows the business person and worker to mutually confirm the work content ordered and the work evaluation. Also, both the business person and worker can quickly and efficiently confirm the necessary information.

3.3.5 Business scouting

This function allows the business person to approach the worker directly by referring to information such as the worker's public profile and task evaluation. In addition, the business person can rapidly and efficiently initiate operations by directly approaching workers.

3.3.6 Administrator management

This function can set a fee for prepayment or additional payment of compensation to the worker. In addition, the function enables stable cash management in terms of the constructed business model, including the management of stable funds on the part of both business person and worker.

Thus, once again, crowdsourcing using ICT enables a business model that achieves optimal and rapid matching between a business person (orderer) and worker (contractor), which has traditionally been difficult to achieve.

4. Current state of crowdsourcing

4.1 Features of crowdsourcing

By using crowdsourcing to carry out work, a business person can (1) assign tasks to workers in a timely and appropriate manner, (2) experts and special skills immediately it is possible to order work from the owned worker, (3) if necessary, secure a large number of workers inexpensively. In addition, crowdsourcing makes it possible to quickly and inexpensively evaluate the labor force outside the organization by judging its expertise and skills; and to easily utilize this labor force.

For example, in the case of ordering work by crowdsourcing, it is possible to match the business person (orderer) and worker (contractor) in a minimum of 15 minutes, in a timely and appropriate manner. Also, in terms of price, it is possible to place an order with a conventional business person at a cost of one tenth to one half. Furthermore, in the case of assigning work to specialists or highly skilled workers, it is possible to use split ordering, while checking the quality of workers online. Therefore, business persons can achieve significant cost reductions in their business operations [9].

Traditionally, business persons "outsource work", "adopt recruitment of mid-career labor", "search for work consignment workers", "conclude employment contract with workers", and "time spent on that", etc.; all of which typically involve significant costs before the start of operations. In addition, after contracting with the worker, the business person must factor in "expenses for time spent in fulfilling the contract (coordination costs)", as well as "expenses to ensure that the contracted worker properly executes the contract content (motivation costs)". However, crowdsourcing enables business persons to execute operations without these cost problems, and thereby enhance their competitive advantage.

At the same time, the worker can scrutinize the work information, such as "work place", "work content", "work amount", "work time", "work experience required", "special skills required", "remuneration", etc.; and can themselves control the amount of work directly. For example, full-time homemakers can pursue domestic work and hobbies of interest during intervals of daily work, such as housework, childcare and nursing care, while also receiving outsourced orders for tasks demanding their particular skills. Thus, various forms of crowdsourcing have been developed in response to the needs of both business persons (orderers) and workers (contractors); and currently, many companies provide crowdsourcing services throughout the world, including Japan.

In crowdsourcing, business persons provide business services such as:

a. "System development, design, writing, photograph and video photography, data entry, questionnaire, interview, answering machine, various agency, check, office work, secretary, etc.", which describe a wide range of operations without limiting the field;

b. "Brochure, catalog, flyer, poster, company information, business card, postcard, logo mark production, etc.";

c. "Announce the company's business issues to the world via the website, and seek outside third parties for planning, technology, and development capabilities not possessed by the company." In addition, there are start-up initiatives such as "a business person that develops a single-focus enterprise" and "a business person that develops a multi-focus enterprise".

4.2 Crowdsourcing platform positioning strategy

Crowdsourcing platforms are typically characterized by the work they handle. Thus, a matrix diagram may be configured based on the "work content", "remuneration type, etc." ordered by the crowdsourcing platform. In the matrix chart, the vertical direction (Y-axis) ranges from "Many Items Business" to "Specific Business", and the horizontal direction (X-axis) from "Low Specialization Business, Simple Business" to "High Specialization Business, High Skill Business". In this way, the diagram can be utilized to locate the full range of crowdsourcing business types [12] (**Figures 2** and **3**).

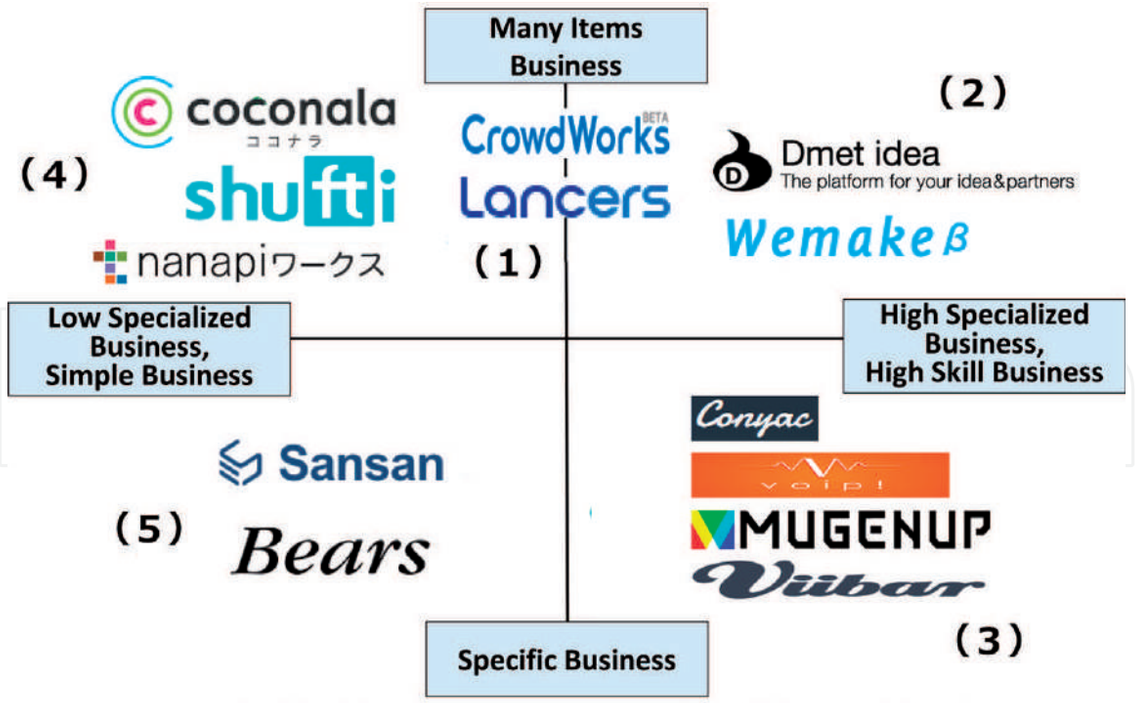

Figure 2.
Positioning strategy for Japanese crowdsourcing companies. Source: created by author.

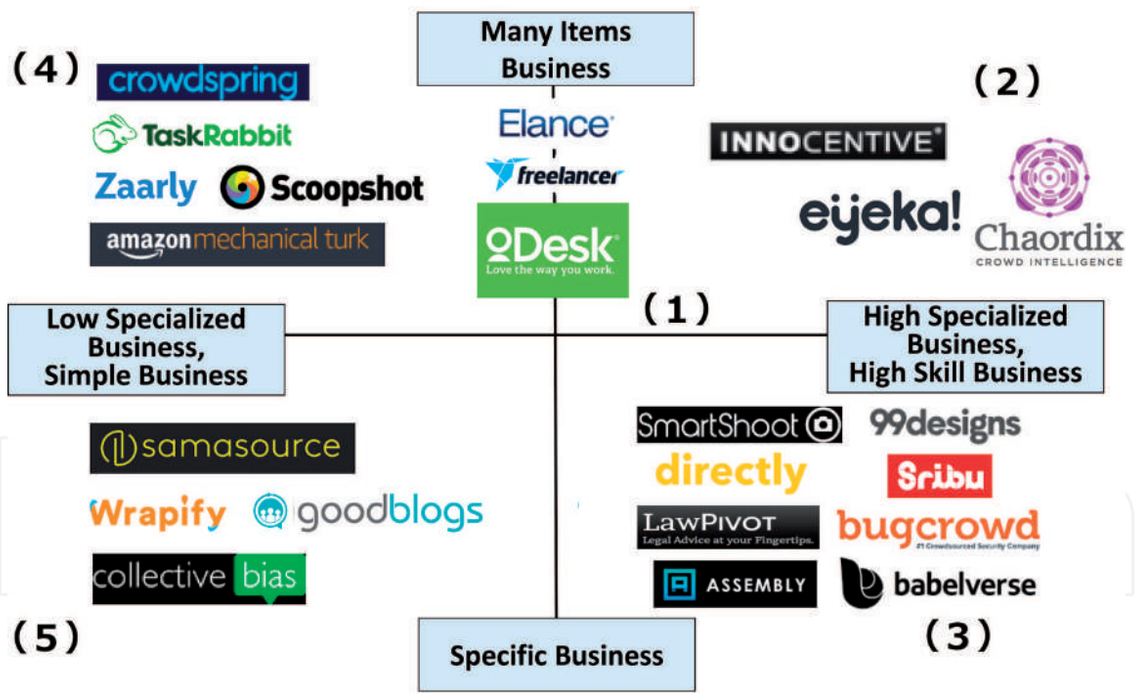

Figure 3.
Positioning strategy for other countries crowdsourcing companies. Source: created by author.

There are five major crowdsourcing platform sectors locatable in the matrix: "(1) Many items business type (general function type)", "(2) Many items business type + high specialization business type (multifunctional type: advanced expertise type)", "(3) Specific business type + high specialization business type (specific function type: advanced functions type)", "(4) Many items business type + low specialization business type (multifunctional type: low expertise type)", "(5) Specific work type + low specialty work type (specific functions type: low functions type)".

4.2.1 Many items business type (general function type)

The crowdsourcing platforms in this service sector are located at the top center of the matrix chart (**Figures 2** and **3**). These platforms differentiate their services from those of other companies by positioning themselves in terms of a "General Function Type". Work types range from "highly skilled work + specialization work" such as programming, writing, translation, web design, etc., to "low skill work + low specialization work" such as simple text creation and data entry provide a wide range of operations.

Major crowdsourcing platforms of this type include "Lancers" and "Cloud Works" in Japan; "Elance" and "oDesk" in the US; "Freelancer" in Australia; and "Witmart" in China.

4.2.2 Many items business type + high specialization business type (multifunctional type: advanced expertise type)

The crowdsourcing platforms in this service sector are located at the top right of the matrix chart (**Figures 2** and **3**). The platforms differentiate their services as "High Specialization + Multifunctional "; and typically offer "many items work" and "work that requires highly specialized skills", for services that combine unique product and service development and existing services.

Major crowdsourcing platforms here include "Dmet idea" (realization of various ideas) and "Wemake" (cardboard furniture using open design) in Japan; "InnoCentive" (expert solutions) in the US; "eYeka" (Ideas competition) in France; and "Chaordix" (question and recruitment of ideas) in Canada.

4.2.3 Specific business type + high specialization business type (specific function type: advanced functions type)

The platforms in this field are located at the bottom right of the matrix chart (**Figures 2** and **3**), and differentiate their services as "High Specialization + Specific Function", offering "highly specialized work" and "work that requires highly specialized skills"; for example, professional photo and video production, real-time interpretation through mobile terminals, order creation of logos and designs in a competitive manner, external blogger requests for company blog writing.

Major crowdsourcing platforms here include "Conyac" (translation), "Voip!" (photograph and video shooting), and "MUGENUP" (illustration production) in Japan; "SmartShoot" (photography, video photography), "99 designs" (design competition), "Directly" (customer care), "Babelverse" (interpretation), "LawPivot" (lawyer), "Bugcrowd" (bug detection), "Assembly" (collaborative development application), and "GoodBlogs" (blog writing) in the US; and "sribu" (design contest) in Indonesia.

4.2.4 Many items business type + low specialization business type (multifunctional type: low expertise type)

The platforms in this service sector are located at the top left of the matrix chart (**Figures 2** and **3**), and differentiate their services as "Low Specialization + Multifunctional", offering "many items work" and "low specialization, low skills work", from simple housework and agency services to office work such as online questionnaires and data entry, and the provision of free-market buying and selling.

Major crowdsourcing platforms here include "coconala" (free market), "nanapi works" (article writing), and "shufti" (office work) in Japan; "TaskRabbit"

(housework/use agency), "Zaarly" (housework/use agent), and "Amazon Mechanical Turk" (input work/questionnaire) in the US; and "Scoopshot" (photography service) in Finland.

4.2.5 Specified work type + low specialty work type (specified functions type: low functions type)

The platforms in this service area are located at the lower left of the matrix chart (**Figures 2** and **3**), and differentiate their services as "Low Specialization + Specific Functions", offering "specialized in specific work" and "low specialization, low skills work" such as mental support for women, training and creation of employment for IT skills, and advertisement with markers.

Major crowdsourcing platforms here include "Bears" (support for women's love), "Sansan" (business card management) in Japan; and "Samasource" (IT skills training and employment opportunities for poor women and young people), "Wrapify" (drivers who want to earn advertising revenue with their own cars), "Good Blogs" (blog writing), and "Collective Bias" (influencer marketing) in the US.

4.3 Advantages and disadvantages of crowdsourcing

In the crowdsourcing business model, the following are the main advantages and disadvantages to (1) the business person (orderer) who outsources the work and (2) the worker (contractor) who accepts the work [13–16].

4.3.1 Advantages and disadvantages to the business person.

4.3.1.1 Advantages to the business person

First, business persons can use crowdsourcing to rapidly and efficiently search for optimal workers. Hitherto, hiring outside the organization (employee recruitment) required time-consuming procedures such as recruitment advertisement, resume submission, interviewing, hiring, a trial period, and regular hiring. In addition, it was impossible to properly judge the quality (such as ability and conduct) of the human resources until sometime after employment. However, through crowdsourcing, the business person can obtain information on the evaluations, reputation, etc. of prospective workers in advance, and can quickly outsource the work according to the work content.

Second, business persons can reduce the cost of doing business by using crowdsourcing. Hitherto, employment involving full-time employees incurred costs (personnel expenses such as salary and social insurance expenses) regardless of how much business was actually conducted; and for business persons, the costs for full-time employees were incurred for everything from simple, labor-intensive operations to highly skilled, complex operations.

Third, traditionally, it was necessary to allocate personnel depending on the type of industry, in preparation for major changes in the volume of work, such as upsurges in business activity or activity that typically occurred suddenly and only at the end of the month. However, ideally, business persons should access human resources as needed, and this is enabled by crowdsourcing.

Finally, business persons can use collaborative sourcing to collaborate with other business entities. Hitherto, hiring full-time employees has been in charge of business (projects), performing duties as individual business within an organization or as group business. However, with crowdsourcing, business persons can divide the work into several sub-tasks, and order only part(s) of the total work content from

respective workers. And in the case of many work-orders, it is possible to perform effective and efficient operations by leaving some or all of the work in a specific field of expertise to crowdsourced workers.

4.3.1.2 Disadvantages to the business person

First, business persons must ensure information security when using crowdsourcing. In crowdsourcing, a business person consigns work to a worker outside the organization (business order); and in the assignment of work, successful operation may require the disclosure of confidential company information, such as ideas, plans, business schemes, and know-how, as well as proprietary customer information, to the crowdsourced workers. Therefore, confidential information may be leaked through the workers. Thus, when outsourcing work to a worker, it is necessary to decide, before generating an order, how to securely handle the relevant confidential or personal information.

Second, business persons must evaluate and manage work quality, intermediately through the crowdsourcing platform. The business person must, for example, confirm that the task is performed on time and with the expected content. Workers, meanwhile, need not worry about the outcome of the delivered work in continuous outsourcing based on past performance and evaluations. This problem is compounded by the fact that, in practice, a business person will have 10 or more simultaneous work orders in progress, making it difficult to ensure assignment to specific workers. Thus, as it is difficult to assign work based on past results, it is typically necessary to confirm each new worker's skills, past work content, and evaluations.

Finally, the business person incurs a fee for using crowdsourcing, as levied by the Internet website (crowdsourcing platform) that mediates between them and the worker. Crowdsourcing platforms typically have specialized areas such as system development, design, image processing, data entry, etc., with varying fees. Therefore, it is important for business persons to make a careful selection of the optimal crowdsourcing platform for their needs.

4.3.2 Advantages and disadvantages to the worker

4.3.2.1 Advantages to the worker

First, workers can use crowdsourcing to make efficient use of their time. Workers can manage the start, end, and rest time for each task, and effectively develop and apply time management skills. Thus, for example, housewives can take advantage of the gaps in housework and parenting; students, the gaps in their class schedule; and company employees, the gaps in their regular employment schedule. In addition, workers can receive orders for tasks that can be completed in a short amount of time, and works for recruiting ideas.

Second, workers can use crowdsourcing to freely determine their working conditions. Workers can work anywhere, regardless of the place of work or building. Hitherto, in the employment of full-time employees, it was necessary to carry out work in a determinate location, time zone, schedule, building, etc. However, in crowdsourcing, workers can work anytime and anywhere (urban, rural, depopulated areas, islands, overseas, and regions, sites, buildings, places, etc., the location does not matter.) as long as they have an Internet environment.

Third, workers can freely choose desirable work content, such as their favorite type of tasks, work that they specialize in, and work requiring skills they possess. In the past, the hiring of full-time employees had to be carried out in a group based on work orders from superiors to subordinates in the organization. With

crowdsourcing, however, workers can be selective in their choice of tasks, choosing those with favorable content or of especial interest, those that make use of sophisticated skills, enjoyable tasks, and tasks well-suited to their abilities.

Finally, workers can use crowdsourcing to avoid troublesome human relationships. In crowdsourcing, email is the primary form of communication between the business person and worker; and since workers do not have to meet the employer directly in order to carry out their work, no extra communication is required. Therefore, troublesome relationships can be avoided, and it is not necessary to have in-person interactions, secure space for them, and pay the transportation cost to get there.

4.3.2.2 Disadvantages to the worker

First, generally, crowdsourced compensation is relatively less than that of full-time employees. One of the advantages of crowdsourcing for businesses is that they can place orders at a lower cost than the cost of conventional full-time employees. Also, though a multifaceted order may be required, the work can typically be subdivided, making it possible to order only a part(s) of the larger project. Therefore, even highly skilled jobs often have relatively low rewards, and workers must compensate by increasing the number of tasks they take on, in order to achieve their financial goals.

Second, workers must confirm the character and integrity of the respective business person through the mediation of the crowdsourcing platform, with communication between the business person and worker basically conducted by email. Workers may thus be hampered in their evaluation, because there is no in-person meeting. In addition, some business persons may, for example, "demand work that is not included in the contract", "become silent while the project is in progress", or "try to avoid paying compensation." Therefore, when actually receiving an order for work, it is necessary for the worker to confirm the order content, rules, etc., and to confirm the integrity of the business person in advance, based on the latter's work-order history.

Third, workers must ensure that their use of the platform is safe and secure. In recent years, advanced cyber-attacks have become a major threat, and attacks from malicious third parties targeting specific organizations are being conducted. If the response to such advanced cyber-attacks is neglected, there is a possibility that "the confidential information of workers and business is leaked", "a fictitious order is placed", and/or "untraceable damage occurs". Therefore, when using a crowdsourcing platform, it is necessary for workers to confirm in advance the relevant BCP (business continuity planning), etc. for any possible failure or trouble in the information system.

4.4 Crowdsourcing market size

In today's information-oriented society, the size of the crowdsourcing market in order for businesses (large enterprises, small and medium enterprises, venture companies, general incorporated associations, NPO corporations, etc.) to establish a competitive advantage in various business fields Are increasing [17–19].

The size of the Japanese crowdsourcing market is 4.4 billion yen in fiscal 2011, 10.66 billion yen in fiscal 2012 (up 242.3% year-on-year), 21.5 billion yen in fiscal 2013 (up 201.7% year-on-year), and 40.8 billion yen expected in fiscal 2014 (189.8% year-on-year) FY2015 forecast of yen 65.0 billion (up 159.3% year-on-year), FY2016 forecast of yen 95.0 billion (up 146.1% year-on-year), FY2017 forecast of yen 135.0 billion (up 142.1% year-on-year), FY2018 forecast of 1820 It has grown rapidly to 100 million yen (up 134.8% from the previous year) [17–19].

A feature of the Japanese crowdsourcing market is that crowdsourcing services are mainly focused on the Japanese market. This is because in the Japanese market, business communication between operators and workers via crowdsourcing platforms is conducted only in Japanese.

Currently, crowdsourcing market in the Japanese culture is limited, and saturation is expected in the near future, and permanent growth of the Japanese market cannot be expected. Therefore, it is necessary to disseminate the Japanese market in the future to unexplored business fields and required workers.

In addition, the Japanese crowdsourcing market can be expected to gain new market growth potential by responding to the global market, including multilingual crowdsourcing platforms.

On the other hand, the scale of the overseas crowdsourcing market has grown to Yen 13.1 billion in 2009, Yen 17.4 billion in 2010 (up 132.8% from the previous year), and Yen 28.9 billion in 2011 (up 166.1% from the previous year) [17–19].

The overseas market size data is the total order amount of work for 15 member companies of Crowdsourcing.org, a US organization related to crowdsourcing, and does not include the order amount of major service companies such as InnoCentive and Amazon Mechanical Turk.

A feature of the overseas crowdsourcing market is that business communication between operators and workers via the crowdsourcing platform is basically conducted in English. In addition, the crowdsourcing platform on the Internet can be used "anytime", "anywhere", "anyone", and "anyone" as long as there is an Internet environment.

Therefore, the crowdsourcing platform is large in size for the global market including the Japanese market. The crowdsourcing platform users are operators and workers around the world. In addition, there are many workers, and it offers high growth potential by providing various services with cheap rewards [20–22].

5. Significance of crowdsourcing strategy

The Crowdsourcing Strategy in the information society has the following three corporate strategies [23, 24].

The first strategy is the crowdsourcing platform's corporate strategy that provides crowdsourcing services to both business persons (orderers) and workers (contractors).

As mentioned earlier, the crowdsourcing platform understands the characteristics of the information society (necessary information can be used "anytime", "anywhere", "anyone", "anyone"), and its business purpose and business plan. A business plan must be formulated based on (business design). And the crowdsourcing platform needs to develop its business by selecting its best position from the five positioning.

In other words, in the crowdsourcing platform, if the business design or business plan formulated by the company is wrong, it will handle non-proprietary fields (specialties), and both business persons (orderers) and workers (contractors). Therefore, the service content with poor quality will be provided.

As mentioned above, the crowdsourcing platform must formulate a business design by understanding the characteristics of the information society (necessary information can be used "anytime", "anywhere", "anyone", "anyone".).

And the crowdsourcing platform needs to develop its business by selecting its best position from the five positioning ((1) many items business type (general function type), (2) many items business type + high specialization business type (multifunctional type: advanced expertise type), (3) specific business type + high

specialization business type (specific function type: advanced functions type), (4) many items business type + low specialization business type (multifunctional type: low expertise type), (5) specified work type + low specialty work type (specified functions type: low functions type)).

In other words, if the business design and business plan formulated by the company is misunderstood, the crowdsourcing platform will handle non-professional fields (specialties) and both business persons (orderers) and workers (contractors) Will provide poor quality service content.

In other words, in the crowdsourcing platform, if the business design or business plan formulated by the company is wrong, it will handle non-proprietary fields (specialties), and both business persons (orderers) and workers (contractors) therefore, the service content with poor quality will be provided.

The second strategy perspective is the business strategy of business persons (orderers) who use the crowdsourcing service provided by the crowdsourcing platform.

Business persons need to develop a business plan (business plan) based on their business purpose and business plan (business design), and then develop a business using crowdsourcing services.

Business persons understand the characteristics of the information society, and perform all operations within the company ("Sales", "Accounting", "Human Resources", "General Affairs", "Information System", "Development", "Research", "Production", "Public Relations", etc.). On the other hand, actively utilize the cheap labor force outside the company.

The third strategy perspective is a corporate strategy that corresponds to work style reforms for both business persons (orderers) and workers (contractors).

Japan has various labor environment issues such as "declining birthrate and aging population, decreasing labor force population due to low birth rate", "health adverse effects due to long working hours, and restrictions on working style due to childbirth, childcare, and nursing care".

In particular, gaps in the work environment and restrictions on work styles affect the quality of work and detract from the work of workers.

The working environment in Japan is longer and less productive than overseas. In this situation, Japan will fall into a negative spiral, where productivity will not increase despite long working hours.

And business persons use crowdsourcing services to establish a competitive corporate environment for rival companies.

The third strategy perspective is a corporate strategy that corresponds to work style reforms for both business persons (orderers) and workers (contractors) [25–30].

In order to improve the working environment, the Japanese government is advocating "work style reform". Japan's work style reforms are not implemented for either business persons (orderers) and workers (contractors).

Work style reform is an initiative that promotes "workers happiness and growth" and "improvement of productivity and creativity of business persons" together with business persons and workers. For both business persons and workers, one of the approaches to work style reform is the use of crowdsourcing services.

6. Conclusion

In today's information society, crowdsourcing attracts attention as a new business model that connects unknown business person (orderer) and an unspecified number of worker (contractor) through Internet websites.

Crowdsourcing seeks to reform traditional employment by providing work that utilizes ICT. In conventional Japanese human resources employment, workers were mainly employed as permanent employees who entered into employment contracts with companies; or as part-time, temporary, or seasonal workers. In each case, they were required to work at a designated work place and time.

However, with crowdsourcing, business persons generally carry out business operations by contracting with a large number of outside individuals. As long as there is an Internet environment, workers can now work anywhere and anytime; in urban areas, rural areas, sparsely populated areas, islands, overseas, etc.

In addition, the use of crowdsourcing has changed the lifestyles of workers. For example, new jobs are provided to residents in depopulated areas and islands, and to people who are raising children, pregnant women, students, and freeters (part-time workers), etc. It also provides a new style of working. Further, it is possible to create new jobs for people who have high skills but cannot make use of their skills in marriage retirement, or due to temporal circumstances.

Crowdsourcing creates new opportunities for professionals and non-professionals alike, and can offer inexpensive services that previously required high compensation. In sum, the spread of crowdsourcing has created new options for how individuals work and live. In the future, it will be possible to explore new ways of connecting business persons and workers through crowdsourcing.

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Chapter

Integrating Information and Communication Technology in Entrepreneurship in Sports: The Way Forward

Oliver Igwebuike Abbah and Uzoamaka Ogwo

Abstract

The topic delved into the use of Information and Communication Technology in sports entrepreneurship, in Nigeria. It discussed entrepreneurship in relation to small and medium scale sports enterprises. The topic explored the areas that Information and Communication Technology can be employed in sports entrepreneurship and the various types of ICT facilities that can be integrated into sports entrepreneurship at the small and medium scale level. Authors also discussed the challenges of integrating information and communication technology in sports entrepreneurship at this level. Finally, the way forward delved into strategies that can possibly be used to further the use of ICT in sports entrepreneurship in a developing economy like Nigeria.

Keywords: information and communication technology, entrepreneurship, sports, sports entrepreneurship

1. Introduction

The sports industry is growing extensively. It is a dynamic and unique industry that is inherently entrepreneurial on numerous fronts. Sports have progressed from a pure pursuit of leisure to a multi-million dollar industry [1]. It is a unique entertainment industry that has been growing in a geometric progression in a commercial environment. Sports provide a lucrative and continually growing marketplace worthy of immense investments [2], thereby providing not only economic impact, but also entertainment for millions of people globally. However, unlike other industries, sport has a unique combination of profit and non-profit organizations that work together to create a competitive environment [3]. While entrepreneurship literature has expanded to include various categories of entrepreneurship, including social, community based, and corporate entrepreneurship, few connections between sport and entrepreneurship exist in current literature.

Business organizations operate in a complex and competitive environment characterized by changing conditions and highly unpredictable economic climate. These changing environmental constraints not only affect their internal structure of business organizations but also their survival, growth and development. Thus, Information and Communication Technology (ICT) is at the centre of this global

change. ICT directly affects how managers decide, how they plan and what products and services are produced. Sports entrepreneurs need to acquire specialized ICT skills in order to develop new and innovative way to satisfy the growing needs of sports consumers.

Reference [4] defined sports entrepreneurs as those persons who act as change agents in the supply of sports products, who attempt to increase the output of the industry, improve the consumer experience, or raise interest in sports products by such means as developing new markets and creating new products. Most discuss on sports entrepreneurs are directed to large scale enterprises by focusing on how new products emerge in the market and the role of ICT in sports innovation. Thus focus has not been directed towards small and medium scale sports entrepreneurship which a graduate of physical education and sports studies can delve into in other to be self-employed. This group of entrepreneurs needs to be developed especially in a developing country like Nigeria where graduate unemployment rate is steadily on the increase. This chapter therefore, focuses on the integration of ICT in the operations of small business enterprises in the area of sports.

2. Sports entrepreneurship in Nigeria

Sport generally defined, means any form of physical activity that aims to improve fitness or mental well-being. The emphasis is on physical expression but it can vary in intensity from low impact sports like walking to high impact sports such as aerobics. Hence [5] considers it to be organized physical activities through which exercise, amusement, fun and play are enjoyed. It provides a lucrative and continually growing market place worthy of immense investments that provides not only economic impact but also entertainment for millions of people globally [2]. The sports industry has thus developed into big business which individuals can harness for entrepreneurship ventures.

The concept of entrepreneur is changing as there are evolving ways to conduct business depending on the market context. An entrepreneur refers to a person, an initiator of business ventures who identifies and harness opportunities and bearing the risk to produce goods and services in order to satisfy the needs of the consumers to maximize profit [6]. Entrepreneurs are innovative individuals who have developed an on-going business activity to satisfy the existing needs of people in order to maximize profit. Entrepreneurs constantly discover new markets and try to figure out how to supply those markets efficiently and make a profit. He is a person that searches for change, respond to change, and exploits change by converting change into business opportunity, [7]. Characteristics of entrepreneurs include being self-motivated individuals who start enterprises relying on their initiative to satisfy existing needs [8]; having the ability to implement their vision and confidence in their ability to develop a business. This means that an entrepreneur is a leader and individual who identifies and solve existing problems. He is creative, innovative, resourceful, opportunist, risk-taker, initiator, skilled and open minded with vision and mission to motivate and drive a business venture with sense of value, team-building and managerial skills, [9].

Entrepreneurship development is the pivot point for economic growth globally. Reference [10] defines entrepreneurship as any attempt at new businesses or venture creation, such as self-employment, a new business organization or the expansion of an existing business by an individual, team of individuals or established business. It is the practice of starting new organizations or revitalizing mature organizations particularly, new businesses in response to identified opportunities [11]. In order words, entrepreneurship requires skill acquisition, critical thinking to

know business opportunities, planning to map out strategies to execute them, and creative and innovative skills to develop new products [6]. These can be found in all fields of endeavor including sports.

The sports industry is growing extensively and offers variety of entrepreneurial opportunities. Sports entrepreneurship is the marketing of sports products and services to satisfy the sports needs of individuals and for profit making [6]. It entails the identification of conditions and procedures in which emergent business ventures with a social orientation are formed. In other words, it provides opportunities to promote innovations, investments, competitiveness, sustenance of sports business ventures and ability to create a market niche for income.

Sports entrepreneurship is a panacea for economic transformation in Nigeria as it encourages innovative activities that facilitate sustainable economic development. [5] noted that Sports organization in Nigeria has resources at their disposal that can be turned around for entrepreneurship development through sports marketing. [5] further noted that Sports also provide tremendous business opportunity in merchandising, whole lots of manufacturing industries have emerged producing sports attires, sports equipment, sports sourvenirs, and services for sportsmen, women and fans. These sports industries are contributing immensely to entrepreneurship development in Nigeria. Sports entrepreneurship is supposed to thrive in Nigeria considering its population and the passion Nigerians have for sports. With a population of over 180 million of which 65% are between 15 and 35 years [12], Nigeria guarantees a long term market for sports entrepreneurship. This is complemented by a TV and media audience of between 25 and 50 million- capable of attracting a fair share of the over N400 Billion advertising spent on sports content and events; and a mobile and internet growth projection of 10% annually [12]. The creation and development of small and medium scale enterprises in the sports ancillary sectors such as merchandising, equipment manufacture as well as investment in venues and facilities construction and content development, management and broadcast, is capable of adding considerably to the size of the industry [12]. However, [13] lamented that the Nigerian sports landscape is replete with immense, yet untapped, business opportunities. The development of entrepreneurial practice among sports experts (especially graduates of Human Kinetics and sports) will go a long way to reducing graduate unemployment rampant in Nigeria.

Sports entrepreneurship has not really been harnessed by Physical education graduates in Nigeria. An industry as large as the sports industry requires educated people to run a variety of sports related businesses [14]. The sports industry entails a variety of entrepreneurial outfits. These may include: health club facilities, sports arena and facility operators, league owner/operators, sporting goods store owners, sports ticket agencies, and sport physical therapists – just to name a few [14]. [14] further stated that there has been significant growth in the coaching and fitness type businesses in recent years within the sports industry. In a study by [15] 23.19 per cent of Physical Education students undertook employment in sports-related occupations including sports coaching in a variety of sports, fitness gym coach, dance instructor, life guard and personal trainer. [16] equally reported that the most entrepreneurial engagement of graduates of physical education is sports events centres. Entrepreneurial practices of Physical education graduates include organizing sports events like inter-house, inter-community sports, etc. (21.30%), coaching (19.03%), establishment of health and fitness club (11.60%) and dance instructor (10.97%) [17]. In other words, organizing sports events like inter-house, inter-community sports, etc. is the most entrepreneurial practice engaged in by Physical education graduates, because most of them are in the teaching profession. This is partly due to the curricular deficiencies of the Physical education programme in Nigeria. The nature of the curriculum utilized for the preparation of prospective

physical education specialists lacks entrepreneurial skills. This is so because the curriculum as stipulated by the National Universities Commission (NUC) benchmarks and minimum standards consistently emphasized school-based Physical Education solely aimed at training prospective graduates to become teachers of Physical Education in schools. This has adversely affected the profession by restricting the role it could play in developing entrepreneurial skills and creating newer job opportunities in order to enhance national economic growth.

Possible entrepreneurial areas in sports that has been neglected by vast majority of physical education graduates include such businesses like sports magazines and newspaper, sports viewing centres, owning a sports shop, running a sports television and radio show, becoming personal trainers, coaching, owning an academy and a gymn [18]. Others include becoming a football scout, nutrition coach, owning a local sports club, sports blog, public relations outfit for athletes, sports betting company and a sports jersey customization business.

Physical education graduates if well exposed to entrepreneurial skills can start a sports magazine or newspaper. Most people in Nigeria are not yet internet connected and as such still depend on the print media for news including sports news. This explains why a lot of people still flock newspaper stands today on a daily basis in order to read the latest news. Most sports lovers are not exempted from this practice as they follow news about their favorite players, athletes and football clubs both at home and abroad. A typical example of such magazines was SportsWorld floated in the 80s in Nigeria and also Complete Sports.

Sports viewing centres are also sports entrepreneurial outfit open to physical education graduates. Due the passion Nigerians have about sports, sports viewing centres are well patronized. During tournaments, tennis match, national and international football matches, club matches, etc.; such viewing centres are always filled up. This is because fans prefer where they will interact with fellow fans and engage in sports discussions about their clubs and favorite players. Most of these centres in Nigeria are floated by non-professionals.

Opening sports shop for sale of sports equipment and supplies are also sports entrepreneurial options that can be lucrative. So many people in Nigeria today engage in exercise and fitness workouts. Such individuals need sports wears in other to participate actively in such programmes. This can include producing customized jerseys and sportswear for individuals and teams. It is also not uncommon to find people wear sports wears for non-sporting activities and gathering either for the fun of it or to show solidarity and support for a team or sport among the people. Moreover, with the ever increasing population of the country, sports shop outlets are promising business. By starting a sports shop in a well visited sports environment, you can serve the needs of fitness junkies by selling sport shoes, trophies, gym supplements, gloves, jerseys, face towels, shakers, and a lot more [12].

Becoming a personal trainer can equally be a lucrative business venture. With the current rise in over weight and obesity brought about by changes in lifestyle and nutritional practices, a great number of people want to train in order to reduce or watch their shape. A lot of women for example, want to look beautiful after childbirth. Such women require the services of well trained professionals to guide and prescribe exercise for them. With a large market looking for ways to shed weight, [12] stated that one could apply for the job of a fitness trainer at a hotel, health centre, and more, to train people daily. More so, some of the trainees may request private sessions from their homes.

Sports coaching have become a very lucrative business in the world today. This is an entrepreneurial option that graduates needs to explore because so many athletes needs to start their career early in order to acquire the basic fundamentals and necessary complex skills in their chosen sport. The key element

is for them to undergo the right training to be able to improve their skills to a national or international level. This ability to a great extent depends partly on the ability of a good coach to guide them. Areas of specialization abound in the field of sports coaching. These include association football (soccer), athletic, basketball, volleyball, hockey, badminton, tennis, table tennis, squash, handball, squash, etc.

Establishment of sports academy gives young sportsmen and women the opportunity to hone their talents, and also offers them exposures that increase their chances of being spotted by higher clubs. This has over time proven to be a profitable venture. By starting a sports academy that trains would-be professional footballers, you will not just be responsible for the success of many future players, but would build a profitable business in the process [12].

Establishing or working in a multi-gym shop is one area with the potential of accommodating a lot of graduates in the area of sports entrepreneurial outfit. Many people flock the gyms and fitness centres these days just to maintain a sexy look. This can be attributed to the strong influence of social media. With the increasing number of people looking for places to engage in a workout, setting up a standard and affordable gym in a residential area is a smart sports business startup.

Starting a sports blog can also be an entrepreneurial outfit worthy to be ventured into. By taking advantage of people's cravings to find solutions to various health or fitness problems, starting a sports blog focused on fitness and general wellbeing could be a great bet [12].

Blogs can serve various purposes such as telling sports stories through a personal blog or media channel. One could also run a fitness blog, where people could learn various ways to stay healthy, how to work out right, and what meals to consume to be in top shape.

Sports betting have become one the most lucrative business enterprise today. So many people are addicted to placing bets on various matches every time there is a game to be played. According to [12], the average revenue generated from sports betting companies daily in Nigeria, is about $7 million dollars. This has made the government to hike the cost of obtaining sports betting license to fifty million naira as at 2016.

3. Areas that ICT can be employed in sports entrepreneurship

In the present digital environment, Information and Communication Technology (ICT) is central and a key factor to economic and national development. It is a pivot point around which every economic and social development revolves globally. Information and Communication Technologies (ICTs) are playing a pivotal role in every walk of life. Information and communication technology (ICT) emerged from the fusion of information technology (IT) and communication technology. In explaining the concept of ICT, [19] defined (ICT) as the handling and processing of information using electronic devices. ICT is defined as the creation, collection, storage, processing, transmission, display and use of information by people and machines [20]. ICT is defined as the various technologies that facilitate communication, processing and transmission of information, goods and services by electronic means. It consists of hardware, software, networks and media for the collection, storage, processing, dissemination and presentation of information (such as audio, visual, text, images) as well as related services. Both traditional technologies (telephone, fax, radio, television, and print media) and newer technologies (such as mobile phones, computers, and internets) are usually included in the concept of ICT [21, 22].

Information and communications technology (ICT) describe the variety of technological tools and resources used to produce, distribute, store and manage information and knowledge [23]. These technological tools include all kind of computer system, software and applications and networking systems which facilitates communicate within the digital world, [24]. To [25], information and communication technology offers new innovation modes for all students at all education levels. In other words, they are those technological tools and resources utilized to create, store, manage and disseminate information. [26] identified these tools and resources as computers, the internet, broadcasting technologies such as radio and television and telephone (including mobile phones). ICT is at the centre of a global change curve that have directly affected how managers decide, how they plan and what products and services are produced. ICT has dramatically transformed the lives of individuals. It provides businesses the scope to analyze data and plan business strategies accordingly. Utilizing ICT means that the data analysis is accurate, thus optimizing profits. ICT has permeated all aspects of human endeavor globally.

The integration of these technologies in sports has brought a paradigm shift in sports industry and has dramatically improved the operations, products and services delivery in sports industry. ICTs have brought about a lot of innovations and revolutionary transformations in sport industry. In cricket, hot spot technology is used to gain information and make precise decision. In football goal line technology is used to detect when the ball crosses the goal line. In sports like badminton and lawn tennis, hawk-eye technology is used to make correct decision [24]. The application of cutting-edge Information and Communication Technologies in Sports has the potential to boost Nigerian Economy and entrepreneurial opportunities for the teeming population. It has a lot of potential to ensure efficiency in sports database management, enhance collaboration, co-ordination, global visibility, easy access to information and networking in sports industry for sustainable economic and social development in Nigeria. ICT will in no small measure enhance productivity of sports products, services, advertisement and marketing. On this note, [27] agreed that all sectors of the economy (trading, manufacturing, services, culture, entertainment, education, medical, transportation etc.) have a lot to benefit from the existing information and communication technologies such as micro-controllers, personal computers, internet access, mobile phones, digital video conferencing, e-mail, multimedia among others. This has offered most Nigerian youth employment opportunities by establishing outlets of sports products and services where people watch football match and other sports activities as well as predict sports outcomes, for example *BetNiger*. The field of sports entrepreneurship has certainly been affected by the penetrating influence of ICT the world over particularly in developed countries. ICT has resulted in very profound and remarkable changes on the quality and quantity of business that can be transacted in the area of sports. Accordingly, ICT applications in sports entrepreneurship has the potentials to accelerate, enrich, deepen and motivate business in the area of sports.

ICT can play a major role in the procurement and supply of sports products and services. This can be achieved through accessing electronic procurement systems. Electronic procurement is an internet-based business process for obtaining materials and services, and managing their inflow into the organization [28]. This is a business-to-business or business-to consumer purchase and sale of supplies and services through the internet as well as other information and networking systems. Electronic procurements includes the use of purchasing cards, reverse auctions, integrated automatic procurement systems to facilitate the buying process. This helps in providing global visibility of sports products and services to allow sports manufacturing companies to have better access and control over their products as well as information flow across supply chain.

Electronic procurement can help to reduce problems associated with procurement and supplies, track data and make it easier for sports entrepreneurs to make their purchases and track their progress. E-Procurement, also known as electronic procurement or supplier exchange, is the purchase and sale of supplies, equipment, works and services through a web interface or other networked system. The technology is designed to centralize and automate interactions between an organization, customers, and other value chain partners to improve speed and efficiency of procurement practices [29]. Typically, E-Procurement web sites can be used to look for buyers or sellers of sports goods and services. Interested buyers and sellers may specify costs of the sports good. E-procurement can also reduce purchasing agent overhead costs. E-Procurement activities that can be utilized by sports entrepreneurs include online indents and demand aggregation, online expression of interest, online bid submission, system supported evaluation, online status publishing, online release of purchase order, letter of award, and order fulfillment and post procurement processes.

ICT provides the best tools for communicating with producers, wholesalers, customers and other business partners. It has unlocked the facilities like e-mail, social media and other messaging platforms for purposes of communication. This can be accessed for making inquiry and contacts by sports entrepreneurs. Also, information search is best achieved through ICT facilities. ICT can positively affect information processes and the information made available to sports entrepreneurs in making business decision.

ICT can be used by sports entrepreneurs in the design and manufacture of sports equipment and supplies. Sports equipment manufacturers can employ computer aided design such as 2D design, Pro-Desktop and Google Sketch up. These are computer software that allows the user to design their products on the computer. Others include rapid prototyping, virtual reality modeling and computer integrated manufacture. This can help to reduce the waste of materials as instant changes and developments can be sent virtually for partners to work on and make adjustments.

ICT can also play major roles in digital marketing of sports equipment and supplies. Digital Marketing according to the [30] is a term that encompasses modern marketing techniques used online, for example, Social Media, Blogging, Search Engine Optimization (SEO), Pay per Click Management (PPC), Branding, Content Marketing, Video Marketing and App creation. [31] stressed that nowadays, digital marketing is indispensable for successful sports retailers. If used properly it is much more than an ideal supplement to traditional advertising. With clever online marketing you can support product sales effectively, maintain your own image and build up your shop as a brand. Digital marketing of sports products and services is a key driver to economic development and is rapidly changing the way sports products are packaged, disseminated, accessed, consumed and sold to sports consumers. According to [32], sport has a unique marketing approach, as most of its messages and images are conveyed through media. ICT in marketing avoids storage costs as orders are readily available through quick response marketing. Also most products for sale are marked with a bar code. These bar codes are scanned at an Electronic Point of Sale machine. This means that individual items can be tracked from end of manufacture, to distribution, to shop and finally to sale. This is essential for JIT production and QRM. This implies that products do not need to be stored as only the essential amount of products are released at a time based on the stock currently held for example by the store.

Advertisement of sports equipment and services is another area that ICT can be employed by sports entrepreneurs. By advertising we refer to the promotion of an enterprise's products and services with the main aim of driving up sales products and services. The use of websites and social networking sites for the advertisement

of sporting events have ushered in a modern and innovative means of disseminating sports news to a wider population. They play a key role in advertising sports events, goods and services. This can be harnessed by sports entrepreneurs to boost their sales and global visibility. Advertisements can be engaged in order to increase sales of product and service, create and maintain a brand identity or image, communicate changes in the existing product line, and introduce new product or service. The ubiquitous availability, access and use of smartphone technologies have continued to promote online branding and mobile internet marketing of sports events, sports goods and services. Therefore, ICT has the capability of transforming sports business if well harnessed.

ICT plays significant role in the area of business management. ICT systems can enable sports entrepreneurs to store, process, analyze and share vast amounts of data. The information available enables sports business managers and by extension the employees to make fast business decisions. Technology has over the years caused an explosion in business and commerce. Many sports enterprises can be revolutionized and remodeled to best practices due to the introduction of ICT in its management. Some of the areas in which technology is crucial to sports business include point of sales systems, the use of ICT in management, accounting systems, and other aspects of day to day running of sports business activities.

ICT can also be utilized for business record keeping purposes. The need for a records management in sports business enterprises cannot be overstressed in the digital age. This has to do with the creation, storage, accessibility and security of digital information. Daily sales and purchases records can be kept with the aid of ICT tools. The ultimate aim of both record management to support, protect and enable the sports business in a cost-effective manner. It is also important it has superior data storage capacity, faster data retrieval, quicker data sorting and analysis. The application of ICT the management of records in sports enterprises therefore, will go a long way in making such records accessible and usable.

Monetary transaction is another area ICT can be utilized in sports entrepreneurship. ICT has made possible various monetary transaction activities like electronic banking. This is simply the use electronic and telecommunications network for banking transactions (making payments for goods and services). Sports enterprises can have Point of Sale (POS) services, online transfers, and the use of credit and debit cards in their business outfits. This encourages non cash payments for products and services.

Storage and data backup is another area that ICT can be utilized in sports entrepreneurship. This can be carried out by use of cloud computing. Cloud storage is a service where data is remotely maintained, managed, and backed up over a network. This is also called storage virtualization. The service is available to users over a network, which is usually the internet. It allows the user to store files online so that the user can access them from any location via the internet. Storage virtualization could be a private storage, like those hosted by a company, or a public storage, like those hosted outside of a company.

ICT has been proven to enhance customer satisfaction in entrepreneurial outfit. The perceived effect of ICT on service quality and customer satisfaction was investigated by [33]. The study established that as the ICT service delivery increases, so does the customer satisfaction. To enhance customer satisfaction, there is need to increase the use of ICT in service delivery. The ICT service delivery affects customer satisfaction. [34] also reported that ICT positively affects customer satisfaction and the ease of carrying out business. In addition, ICT have created opportunities for sports equipment entrepreneurs to advertise their business online. This allows wide visibility and remote access for the product [6]. Customers can thus order for sports equipment and services online. They can equally make online payments without

the barrier of physical boundary. In the area of sports equipment design, technology is also playing a growing impact [6]. [35] reported that the application of ICT to sports serves a role in creating whole new opportunities for entrepreneurs and provides sports events and tools such as Computer Assisted Design (CAD) which can play a very important role in sports equipment.

4. Types of ICT facilities that can be integrated into sports entrepreneurship

The rise of ICT has paved the way for various innovations. With the digitization of business through ICT, more and more businesses are increasingly leveraging the benefits of digital tools to improve their prospects and sports entrepreneurs are not exceptions. Information technology infrastructure includes computer hardware, software, data, storage technology, and networks providing a portfolio of shared information technology resources for the enterprise [36]. ICT facilities that can be integrated into sports entrepreneurship can be categorized into two: software and hardware.

Hardware refers to any physical part of the computer system which you can physically touch, hold, pick or move. Software on the other hand, refers to a set of instructions which tells the computer what to do. These can be integrated for one purpose or the other in a sports enterprise.

4.1 Computers

Computers became so popular in business establishments solely for secretarial purposes namely word processing and spreadsheet management. However, computers are today, used to carry out different functions in a business enterprise. Computers that can be used in business include desk tops, laptops, notepads, servers and even smart phones. Their uses in business are endless. Different kinds of programs and operating information, known as software, are used by computers to do specific tasks. Productivity tools such as Microsoft Word, a word processing package, and Microsoft Excel, a financial spreadsheet system are used software used by business entrepreneurs. Businessmen/women choose software depending on what they intend to do.

Computers are now a vital tool for communication. Communication is the soul of any business enterprise especially in sports. It is the life wire and key driver of sustainable sports development around the world. Computers have enabled concepts such as remote working and flexible working schedules. It has also enabled businessmen and women to communicate with their customers. This is achieved through e-mail, Skype, zoom, short message system, social media platforms, etc. It has made it easier for customers to communicate with business enterprises in a timely and efficient manner. The biggest change to the sports industry has been the advent of social media. With platforms such as Twitter, Facebook, Blogging, Instagram, YouTube etc. There are millions of users of sports brands that sports entrepreneurs can use to promote their sports products and services, [30]. The use of ICT in sports has bridged the gap of physical boundary as sports fans can view sports activities from any part of the world.

Computers are also used for marketing of products and services. This is possible when the business outfit has internet connectivity [37]. The entrepreneur can also utilize different social media platforms to market their products and services. Computers are also very important as an accounting tool. They are critical for performing such tasks as preparing invoice for customers, calculating payroll, keeping

income and expenditure accounts, among others. There is online accounting software like 'Xero' which does the work of an accountant and book keeper. It has the ability to track expenses, profits, and reconcile debts. It can also send invoices and create expense claims.

4.2 Digital video camera

The use of digital video cameras plays an indispensable role in recording performance of players in the field. The recorded video can be broadcasted live or uploaded later on. It can be used to record motion pictures, capture moving images and synchronize sound. Recent advanced technology used high-tech video recorder to record any performance and can directly convert them to three-dimensional data using high level software, [24].

4.3 Printers

Printers are necessary in the event that you have the need to print out your marketing materials or need to handle basic jobs. Printers will enable you minimize costs by encouraging your employees to work as a paperless office whenever possible [38]. Printers are also needed for printing of contracts, legal documents, and other business materials. Some printers have multiple functions including scanning, photocopying, and faxing [38].

4.4 Data storage devices

External Hard Drives are used to store certain types of information and help you stay organized. It is an important tools for entrepreneurs especially those that do not want to store information in the Cloud or on their computers' hard drives. External hard drives have the ability to protect valuable and sensitive business data in the event of an accident, such as a fire. It can also be used as back-up devices.

4.5 Cloud computing

Cloud computing has offered a paradigm shift in sports industry and it is currently gaining grounds, popularity and acceptance globally. Cloud computing holds a lot of potentials, innovations and the capacity to transform the sports industry to a multi-million dollar business enterprise. Cloud computing involve storing data and information away from our physical location as against storing them on local hard disk or local servers. The term cloud computing means storing and accessing data and programmes over the internet from a remote location or computer instead of in the computer hard drive [39]. This is as opposed to local storage and computing (storing data or running a prgogramme from the local computer hard drive). Therefore, for it to be considered *cloud computing*, one need to access data or programmes over the internet. The end result is the same; however, with an online connection, cloud computing can be done anywhere, anytime, and by any device such as smartphones, tablets, laptops that is connected to the internet. When the need to use such data or information arises, it is accessed and obtained through the internet. This makes such data and information accessible from anywhere. This is the essence of cloud computing.

The concept of cloud computing is immensely popular among entrepreneurial outfits due to the efficiency it provides in business operations. Some of the noteworthy benefits are cost savings, remote working, efficiency, flexibility, future proofing, morale boosting, and resilience without redundancy. It offers speedy, on-demand and easy access to sports data, products and services regardless of time and geographical

boundaries. Adequate security of sports data from natural disaster, power and server failure is ensured. Cloud computing provides improved agility and time and resource management for businesses. Businesses are increasingly shifting to the clouds to leverage its many benefits. For cloud computing to be effectively utilized, a good internet connection and a commendable WiFi connectivity are important.

4.6 Mobile phone

Mobile phone can be used to a great extent for short message service and multimedia message service. This can be used for communication purposes and advertisement placements. With over a billion handsets worldwide with majority being internet enabled, mobile phones have been one of the fastest adopted consumer products of all time which can be harnessed for by entrepreneurs. Mobile phone has made possible wireless applications that enable person-to-person messaging, email, banking, news, games, music, shopping, ticketing, and information feeds. A lot of information and even advertisement can be carried out in Facebook, WhattsApp, You tube, etc. These applications can be integrated into sports entrepreneurship in order to enhance business activities. [40] noted that Sport can provide meaningful content for mobile technology, which entails the use of cellular communication technology to distribute information to consumers via cellular phones.

4.7 The internet

The internet is a global communication network that provides direct connectivity to anyone over a local area network. The internet service can be accessed through an internet service provider (ISP). It is a public network that is connected and routed over gateways. The ISPs are connected to the network service providers, and eventually to the internet appliances. Communications has been enhanced to a great extent through the internet. The internet has enabled improved internal communication, improved business partnership channels, effective marketing, sales, and customer support and facilitated collaborative activities support. In the area of business, the internet has enabled faster time to market goods and services, potential for simultaneous engineering and collaboration among business enterprises, lower design and production costs of goods and services, improved customer relationships, and creation of new business opportunities. It has also reduced operational costs for business enterprises. These can to a large extent improve the business outfits of sports entrepreneurs if well harnessed.

4.8 Business process automation (BPA)

ICT has enabled the automation of business processes. Business process automation (BPA) is the automation of the processes of business through technology. This allows businesses to cut costs and increase productivity. It also improves efficiency, increases workflow and saves time. BPA basically implies automating processes and workflow such as document approval process, employee on-boarding process, billing, tracking metrics, collecting customer data, monitoring, etc. Automation software is available for such purposes.

4.9 Network server solution

Network server solution is important if the sports entrepreneur will need any type of network to support the data base, email applications, and other files in the business. The entrepreneur has the option of choosing from several server solutions

based on the amount of storage needed in the business, security requirements, and backup options required. There is need for the entrepreneur to work with a specialist in the area of networking to ensure the right package based on current and future needs are procured.

4.10 Wireless router

Wireless router is important to ensure that the business outfit is connected to the internet wirelessly. A strong wireless connection can ensure high-speed connectivity to all linked computers and mobile devices [38]. It will also reduce the need for extra cables running in and around the business enterprise.

5. Challenges of integrating ICT in sports entrepreneurship in Nigeria

Notwithstanding the potentials of ICT in sports industry in Nigeria, there have been a lot of factors militating against the effective integration of ICT in sports entrepreneurship in Nigeria such as the following:

- **Lack of ICT and e-business skills:** lack of fundamental ICT skills such as navigating the internet and troubleshooting is a serious deterrent for most people who intend to venture into sports entrepreneurship in most developing countries. There is lack of ICT technical expertise needed in managing sports businesses and this is one of the serious barriers in developing countries

- **Lack of Locally Manufacturing Industry**: most ICT facilities used for sports in Nigeria are imported products and there is a very high import duty on such facilities which make them very costly and unaffordable. This has been a bottleneck for sports entrepreneurs who may not have enough capital.

- **Poor Internet Connectivity:** poor network and broadband internet connection has been a bottleneck for the successful implementation of ICT in sports entrepreneurship in Nigeria. The growing digital divide in developing countries is a serious impediment to the utilization of ICT in sports entrepreneurship.

- **Lack of awareness:** ICT application in sports entrepreneurship has the potential of creating millions of job opportunities which are yet untapped. Most people in Nigeria are not yet exposed to the potentials of ICT in sports entrepreneurship.

- **Cost:** the initial cost of purchasing the ICT facilities such as computers, smart phones, internet connection, bandwidth, hardware, software and maintenance cost has been a very serious challenge facing potential entrepreneurs who want to venture into sports business**.**

- **Lack of Government incentive for sports entrepreneurs**: there is lack of incentive by the Nigerian Government to support sports entrepreneurship. The sports betting sector is blossoming and growing astronomically in Nigeria. However, there is lack of incentive for young Nigerian entrepreneurs who have the passion to venture into such entrepreneurial opportunity. Hence, they are faced with the challenge of acquiring the ICT facilities such as mobile phones and internet connection required for such sports business venture. Some young

sports entrepreneurs who have the passion to establish sports viewing centres do not have the capital.

- **Epileptic Power Supply**: one of the major constraints for integrating ICT in sports entrepreneurship in Nigeria is poor power supply. Most sports entrepreneurs usually run the business centres on power generators, adding to cost of sports goods and services. This has been a very serious setback to the integration of ICT facilities in sports entrepreneurship in Nigeria.

6. The way forward in the use of ICT in sports entrepreneurship in Nigeria

The success of integrating ICTs in sports entrepreneurship hinges on proper training, adequate funding, motivation and creating enabling environment for potential sports entrepreneurs to encourage best practices in sports industry in Nigeria. The current transformation, innovation and revolutionary changes brought by the integration of ICT in sports industry demands an urgent revamping and repositioning of sports industry in Nigeria. In order to ensure the integration and sustainability of ICT in sports industry to boost entrepreneurship in Nigeria, the following measures should be adhered to:

- Nigerian government need to ensure adequate human capacity training on ICT skill acquisition to enable individuals develop innovative ICT skill, knowledge and capacity to boost sports entrepreneurship in a competitive global digital environment. There is need for government, policymakers and stakeholders in sports industry to ensure the integration of ICT and e-business skills acquisition into education curriculum at all level. Such training and skill acquisition must be proactive, tangible, and in real time where all the necessary tools, machines, equipment and ICT facilities should be adequately provided.

- Creating an enabling environment by the government to encourage investments in local content production especially in the area of sports goods and services using ICT facilities.

- Access to broadband internet connectivity has the potential of global visibility, connecting people, places, businesses and services without the problem of physical boundary. Sports business owners highly depend on broadband internet connectivity for global access, easy marketing and effective distribution of sports goods, products and services. Hence, government should ensure the availability and accessibility of internet connection is very critical for the effective implementation of ICT is sports entrepreneurship in Nigeria

- Creating awareness through sensitization programmes on the potentials of integrating ICTs in sports industry in Nigeria to boost sports entrepreneurship

- Government should subsidize the cost of ICT facilities to encourage potential entrepreneurs who may want to venture into sports businesses. There is need to give incentives to young sports entrepreneurs to start off their business

- Tackling the issue of poor power supply in Nigeria to encourage easy business operation is very critical.

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Chapter

Selecting a Laboratory Information System for Biobanks in Low- and Middle-Income Countries

Samuel Kyobe

Abstract

Biobanks in low-and middle-income countries need significant infrastructural support to meet ISBER Best Practices to support population-based genomics research. ISBER recommends a Biobank information management system that can manage workflows from biospecimen receipt to distribution. The H3Africa Initiative was set out to develop regional African Biobanks where Uganda, Nigeria, and South Africa were successfully awarded grants to develop state-of-the-art Biobanks. In this chapter, we review the African experiences, processes, and recommendations for information management systems for use in the low-and middle-income country context. We provide a balanced basis on which institutions can deliberate their decision between an out-of-the-box service and a commercial enterprise.

Keywords: LIMS, LMIC, Biobanks

1. Introduction

Biobanks require the linkage of high-quality material to data housed in a laboratory information management system (LIMS) which tracks each sample. A founding principle of H3Africa is to ensure that DNA (and possibly other clinical biological material) would be stored in Biobanks for future research purposes [1, 2]. The value of this material is partially determined by the associated phenotypic data. Management of this data and sample tracking in compliance with national and international best practices and ethical guidelines requires a refined data management system [3, 4]. According to the International Society for Biological and Environmental Repositories (ISBER) Best Practices, a computer-based inventory system should be in place to track the location and pertinent annotation of every specimen in the Biobank [3]. The system should also track significant events during a sample's existence from collection to destruction, including sample thaws, receipt and/or processing delays, processing, transfer of the sample within the repository, specimen distribution and return, and destruction [3–5]. These ISBER Best Practices, as well as others from around the world, are under consideration to codify an International Organization for

Standardization (ISO) norm as the basis for a new international accreditation program for Biobanks [6]. Several factors hinder the successful implementation of a Biobank laboratory information management system (LIMS) in low- and middle-income countries. This chapter discusses the experience of H3Africa Biobanks in the evaluation and setup of a sustainable Biobank information management system.

2. The importance of LIMS sustainability

Biobanks should develop strategies for long-term LIMS sustainability. Reliable and adequate sources of funding are key to the sustainability of LIMS. Commercial LIMS vendors require the payment of annual support fees, unlike open-source LIMS. The risk of liquidation needs to be considered as it impacts LIMS support and maintenance and the long-term viability of the Biobank. Biobanks should employ cost recovery measures for users to ensure sustainability.

3. LIMS harmonization in the case of H3Africa Biobanks

Before the H3Africa program, each Biobank had its LIMS that met their current needs. Since the commencement of the program, the Biobanks have either acquired new LIMS or upgraded their existing systems following a thorough LIMS assessment program. The Biobanks conducted a harmonization exercise to ensure the interoperability of the LIMS across the three sites. Pilot studies conducted between H3Africa Biobanks integrated data sharing and importation protocols through a pilot biospecimen and data exchange. Data exchange harmonization is essential if Biobanks are to operate efficiently in networks like H3Africa to support population genomics studies. Biobanks need to define an agreed sharable set of data and data formats for harmonization and interoperability to facilitate exchange. Pilot projects with virtual data transfer protocols were undertaken successfully suggesting that this harmonization has been effective.

LIMS general information
• What development tools have been used in the creation of the LIMS (e.g., Microsoft C#)?
• Is the system scalable and therefore suitable for small organisations as well as global corporations?
• What are the system requirements?
• Does the system allow concurrent operation of three or more database groups in the standard system?
System configuration/customisation
• Is your system configurable so that it can exactly meet our requirements? If yes what are the requirements? If no, what are the alternatives?
• Is the system configurable by the non-programmer and without use of special languages?
• Are user configuration changes supported by the vendor? Is there any extra cost?
User access/security
• What is the security access system in detail?
• Does your system password requirements comply with 21CFR Part 11?
Functionality—sample/work registration

• Does your system support the following types of registration: single sample; single sample with copy feature; batch registration with/without copy feature; bar-code support; registration templates; registration from external system and/or scheduler; spreadsheet style registration including data capture from Excel; can details of submitters and sample types be viewed from the registration screen; can reports, e.g., worksheets and labels be automatically generated
• Does system allow fields to be populated automatically by defining a default value within the system which can be overtyped by a user with suitable authority?
Functionality—sample receipt
• Is a sample receipt function provided with the system? Useful when some work is pre-registered prior to the availability of the samples. The receipt function is needed to track the arrival of the samples. Useful in checking whether all expected samples arrive in the laboratory and the time interval between registration and receipt for each sample can be measured. The sample turnaround time in the laboratory should be measured from the receipt date and time.
• Does sample receipt allow for single sample, multiple sample, batch sample and global sample receipt utilising bar-codes where needed?
Functionality—sample preparation
• Is a sample preparation function provided with the system? This would be used to indicate that samples must complete the preparation stage before they are ready for testing.
• Does sample preparation allow for single sample, multiple sample, batch sample and global sample preparation?
Functionality—result entry
• Does system include: result entry by sample—entry of any/all test results for a single sample; result entry by test—entry of one test result for multiple samples; result entry for multiple samples and multiple tests in spreadsheet style; result import from a variety of sources including files and instruments; viewing of results previously entered using same selection criteria as for selection of samples for result entry; viewing of test status.
Reporting
• What reporting tools does the system support?
• Is event triggered reporting—reports generated by sample status change, for example—included?
System support
• If I have a support question can I telephone a help-desk and immediately talk to a technical person familiar with my system? If yes, where would this person be located and what time can I call them? If no, what support scheme is in place?
• Does the vendor have global coverage if relevant? If so what are the support centre locations?
• Are new version upgrades supplied to customers at no cost?
• How much effort is typically needed for the implementation of an upgrade and what do I have to pay?
• Will an upgrade preserve my configuration or custom code as well as my data?
• Do you guarantee that we will always be able to upgrade to the next version?
Miscellaneous
• Does system allow storage of BLOB files, e.g., pictures, documents (consent forms) associated with a sample or a test?
• Can a document management capability be fully integrated within the system?
• Describe the sample tracking features of your LIMS. How is this used to monitor inventory for example?
• Can I have separate databases for different departments within my organisation (they may be in different locations)? Can these databases be configured differently?

Table 1.
Summarised checklist to consider while choosing a Biobank LIMS (a detailed checklist can be accessed via biorepository.h3africa.org).

3.1 Checklist for choosing an LIMS and H3Africa Biobank as model

H3Africa required that the three Biobank workflows would be harmonized through interoperable LIMS to enable data integration and exchange. Key elements that were considered while choosing a LIMS for the project included (a) customizability and usability; (b) interoperability with other LIMS; (c) access to revisions, updates, patches, and maintenance releases; (d) cost and access to technical support services; (e) maintenance and associated costs; (f) multiuser/multisite support; (g) robustness to handle large volumes of sample information; (g) security systems (audit trail, user roles, and privileges, etc.); and (h) type of (open-source or commercial) LIMS. Here we presented a summarized checklist (**Table 1**) we considered while choosing a Biobank LIMS; however, a detailed checklist can be accessed via Biobank.h3africa.org website.

4. IT infrastructure

In addition to high acquisition costs, commercial LIMS requires an IT infrastructure to fully support their function. IT infrastructure is a combined set of hardware (e.g., servers, computers), software (e.g., operating software), and network systems required to deploy and support the LIMS. As biospecimen numbers grow, there is a corresponding decrease in LIMS functionality such as very slow loading and processing speeds, which is linked to the supporting IT infrastructure [7]. Therefore, a LIMS infrastructure should have the ability to scale to meet the needs of the community it serves. Institutions that are unable to support a Biobank LIMS on their own should team with other institutions to develop and deploy a shared Biobank LIMS infrastructure. By using a shared infrastructure, each participating institution could maintain components of the infrastructure independently, while also collectively managing the entire Biobank architecture. This will not only provide an economic benefit but will also provide an environment for harmonizing complex, but still critical, components of a LIMS such as structured data files and data models, as well as standards for data transmission.

4.1 User support services

Commercial LIMS often require user support services such as customization, implementation assistance, annual licenses, maintenance, and update, although the need for these services may vary over time especially as users become experienced with the system. User support can be provided in several forms including telephonic support and on-site support. There is an additional cost to access such services, which may be minimized by conducting thorough initial training and license negotiation. Many commercial LIMS vendors have no support networks or offices in low- and middle-income countries. This increases the costs of user support services because of airfare, accommodation, and other attendant costs to access the services. In such circumstances, low- and middle-income country Biobanks should endeavor to use other remote access technology to access support such as public IP addresses that enable external access and manipulation of the LIMS. Unlike commercial LIMS, open-source LIMS systems do not have user support services, and the user must troubleshoot locally which can be challenging or impossible based on technical capacity.

5. Open-source LIMS and commercial LIMS options

Commercial LIMS are systems whose source code is developed for sale and requires authorization from vendors before licensed use. Open-source LIMS are systems whose source codes are made available for distribution at no cost [8]. During the H3Africa Biobank implementation phases, it was decided to implement commercial LIMS in support of the collections. Commercial LIMS are significantly more expensive upfront than open-source LIMS and are less flexible for end-user adaptations but do not require local expertise to support. Despite some features of modified open-source LIMS that might seem more applicable to the low- and middle-income country setting, there were significant concerns regarding the stability of such systems and the lack of standardization. Additionally, it was clear that the adaptation and maintenance of such a system would require highly specialized staff at each of the Biobanks and that this may create differences among the Biobanks which could cause potential delays in the interlaboratory transfer of data and material.

In general, both open-source and commercial LIMS have some benefits and drawbacks. Open-source LIMS are quite cheap and most are entirely free to acquire, easily customizable, and open to various platforms such as Linux, Window, or Unix. However, they are not secure to data hacking, fixing bugs requires IT expertise, and there are no user support services.

Commercial LIMS are highly secure and reliable and have dedicated user support available in the form of telephone and email support. Software updates are provided regularly most often free but sometimes at a user fee. Some are customizable and adhere to the ISO 20387:2018 [9]. However, they are expensive; in our experience, one commercial LIMS was purchased at US$120,000. Some are associated with annual renewal licenses or user fees which can be very prohibitive and affect the Biobank sustainability. One of the major drawbacks of commercial LIMS is discontinuation of the product without the consultation and consent of users leaving them in jeopardy.

6. Budgeting for LIMS in the H3Africa Biobanks

The functioning of Biobanks requires stability and continuity of the LIMS. In addition to the purchase of commercial licenses, some unforeseen expenses were encountered in the implementation of the commercial LIMS in H3Africa. These included training costs for staff and more complex hardware requirements, unlike for open-source LIMS. In the case of H3Africa, it was possible to budget for these contingencies, but these costs may become prohibitive for smaller Biobanks outside of a funded grant. In these cases, innovative solutions may include forming consortia with other facilities and purchasing a multiuser license. This may have the added advantage of enabling a shared forum for dealing with other problems. However, to keep each repository with separate views, specific role-based security would have to be implemented for each user's collections. It may also only be necessary to acquire specific modules within a commercial package to keep the costs lower.

Retaining and training staff to operate LIMS has presented some challenges for H3Africa. Some strategies were employed, including actively headhunting individuals with experience, ensuring that the LIMS manager feels integrated into the Biobank management structure, and training junior staff to ensure an adequate succession plan. Also, including training clauses within purchasing agreements have

mitigated some of the risks of purchasing complex licenses, but ongoing training represents an essential need and should be part of a Biobank's quality management system. Discussion regarding formulating in-house training material for LIMS support is ongoing across all three H3Africa Biobanks to stay aligned with training and SOPs.

7. Conclusion

Developing a state-of-the-art Biobank requires considerable capacity and staff development including the acquisition of formal training, equipment, and software. Key among the Biobank infrastructure is a LIMS. Choosing a LIMS in low- and middle-income countries requires careful consideration of the various factors that could affect its successful and sustainable deployment and utilization. H3Africa Biobanks operating in a consortium have highlighted key factors and recommendations that affect successful LIMS implementation.

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