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IJIPC is being positioned as an internationally refereed journal published bi-annually in (May and November) by the Faculty of Communication and Information Sciences, University of Ilorin, Nigeria. Thus, issues will be identified as Volume 1, (Issue 1, May/June), 2013, Vol. 1, (Issue 2, November/December), 2013 etc. It is dedicated to the exchange of the latest research and practical information in the field of data/information processing, communication and management. The journal publishes original research and case studies by academic, business and government contributors on the key areas of computing, information science, library science, telecommunication and mass communication including best practices, policies, and guidelines.

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Dr. A. Tella,

tella.a@unilorin.edu.ng, editorijipc@unilorin.edu.ng, tella.a@unilorin.edu.ng

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GRAPHICAL ANALYSIS OF ROAD CRASHES IN KWARA STATE USING DATA MINING APPROACH

Olagunju Mukaila,

Department of Computer Science,
Kwara State Polytechnic, Ilorin.
Olamukaila@yahoo.com

Adeniyi A. Emmanuel,

Department of Computer Science,
University of Ilorin, Ilorin.
abidemisteven@gmail.com

&

Mabayoje, M. A.

Department of Computer Science,
University of Ilorin, Ilorin.
mmabayoje@gmail.com.

Abstract

Road accident is very common nowadays due to bad roads and some other factors such as intake of alcohol, overspeed and inexperience of the drivers. The main objective of this project is to analyze the trends in relation to a number of people survived, injured and category of people involved (either youths or adults). This study uses decision tree in data mining couple with data analysis which was carried out with SPSS. This study will definitely assist the road users and government to measure the trends of accidents within the given period.

Keywords: Accident, Data, Crash, Road, SPSS, Decision Tree

Introduction

Road safety experts and researchers deal with large volume of quantitative information and collected statistics, in order to understand and estimate the social and economic cost of the accidents and to be able to introduce safety plans in order to prevent or reduce occurrences of accidents. The road traffic and accident statistics must be presented in such a way to make it easier to be both recognized and interpreted by a human operator. Each year, approximately 1.42 million people die as a result of road traffic crashes according to the World Health Organization (WHO, 2013), Road traffic injuries are the leading cause of deaths among young people, aged 15 to 29 years, and without action, road traffic crashes are predicted to result in the deaths of around 1.9 million people annually by 2020. The population projection of kwara state as at 2011 was 2.7 million. Additionally, between 20 and 50 million people of the world and more people suffer non-fatal injuries, with many incurring disabilities as a result of their injuries (WHO, 2013). Road crash occurs around the world. Statistics shows that over 3,000 people are killed in car crashes everyday and over 40,000 people killed each year throughout the world (OECD, 1997).

Afukaar (2001) takes an exploratory view of speed control in developing countries. The issues, challenges, and opportunities of reducing road traffic injuries are explored. Over Speeding of a vehicle is considered as a factor in the causes of road traffic crashes. The effectiveness of various speed control measures was examined on speed control crashes in developed country and published works on speed control measures in both industrialized and developing countries were examined. The results show that pedestrians were the main victims of road traffic injuries. The dominant driver error assigned by traffic police includes the loss of control as a result of excessive reckless speeds. The speed factor alone counted for more road traffic accidents on our roads. While the enforcement of speed limits by traffic police may not be affordable for most developing countries, rumble tripe and speed humps were found to be useful alternatives. While information about crashes has long been recorded, the tools to analyze the data are becoming more advanced and more available. Additionally, innovative data collection methods provide additional opportunities to obtain a wide array of characteristics of transportation systems. This research work will not be accurate without taking about data mining, as data mining is the main method used to extract a large amount of data. In this research work, decision tree data mining techniques are used as the method of data analysis.

Data mining is a promising area for dealing with the increased, and stored data that has been generated in our times. It is the extraction of implicit, previously unknown and useful data. In this research work we have explored some of the data mining techniques, tools, applications and search engines for accident investigation and traffic analysis. Most of the accident investigation methodologies are based on scenarios of the accident occurrence and simulation of a accident situation. The costs of fatalities and injuries due to traffic accident have a great impact on society.

Engineers and researchers in the automobile industry have tried to design and build secured automobiles, but traffic accidents are unavoidable. Some researchers have been utilizing real-life to data in studying various aspects of road crashes traffic accidents. Some measures have to be taken to reduce accidents, and these measures should be based on scientific and objective surveys of the causes of road crashes accidents and severity of injuries. Our study highlights various tools, techniques, and applications of data mining in accident analysis which will eliminate deficiencies of other techniques but cover their advantages.

A branch of research known as “knowledge discovery in databases” (KDD) is concerned with how data can be transformed into understandable patterns or models. The process of KDD is interactive and iterative, involving steps such as data selection, data reduction, data mining and subsequently, the evaluation of data mining results (Ester et al., 2001). The data mining step is defined as “the extraction of implicit, previously unknown, and potentially useful information from data”; it is performed by applying discovery algorithms, and produces understandable patterns (Witten and Frank, 2005). Each data mining method produces an output in a different format, such as

clusters, decision trees, neural networks or rules. Often, the aggregation of knowledge from combining more than one method presents the best results (Bekhor et al., 2007).

Data mining methods are suitable for retrieving knowledge from large databases. Decision Trees are a tree-like graph of decisions and their possible consequences; division tree divides data up at each branch point without losing any of the data (Berson et al., 1999). Decision trees of data mining techniques are less appropriate for estimation tasks where the goal is to predict a value of a continuous variable, and time-series data (Bekhor et al., 2007). There are two different algorithms that can be used to make decision trees: Classification and Regression Trees (CART) and Chi-Square Automatic Interaction Detector (CHAID). The CART method constructs binary trees, where each internal node has exactly two outgoing edges. For each input variable, The CHAID method finds the pair of values that is least significantly different with respect to the target variable (Rokach and Maimon, 2008). Decision trees are advantageous because they are very self-explanatory and are easily used to make predictions, and can handle raw data with little or no pre-processing.

Bad roads or poorly-maintained roads cause most of the road crashes traffic accidents that happen each year in the state. An 18-month study conducted by The Pacific Institute for Research and Evaluation examined information from the National Highway Traffic Safety Administration, Federal Motor Carrier Safety Administration and other government agencies and concluded that road problems like potholes and iced-over stretches of highway cause more than 42,000 deaths a year.

There are several types of bad driving situations which exist in the state, including:

Potholes: Severe accidents can occur when blacktop or asphalt are missing in large chunks from the road.

Ice patches: Ice patches can form even without rain or snow. They typically form in isolated areas on the road.

Shoulder drop-off: A drop-off region can present a serious danger to drivers.

Oil and chip: These are temporary fixes on roads before they are resurfaced. Oil and chip areas can become slippery when left for extended periods of time.

Construction work zones: Lanes shift and uneven roads are some of the issues involved in construction areas.

Slick roads: Slippery surfaces cause hydroplaning to occur.

Despite the fact that road transportation is the commonest means of transportation in the developing country compared to other means, air, rail, and water, the technology has made this better than the animal means of transportation, Nigeria as a country has tried to minimize the rate of road crashes traffic among its populace. It was estimated that the number of registered vehicles in Nigeria rose between 1988 – 2004 from 600,000 to 6,000,000. Despite the happiness and change of quality of family lives associated with owning a vehicle, its possession has made so many families bereaved of their

breadwinners or lovely ones due to an unprecedented rate of road traffic accidents. It seems as the rate at which vehicles increases in our country, also increases the rate of road crashes traffic due to the lawlessness involved in handling a vehicle such as lack of obedience to the rules and regulations of driving or of using the road, this is called human factors such as Lack of knowledge of road signs and regulations, illiteracy, health problems like poor eye sight, excessive speeding, alcoholism, drug abuse, arrogance, over-confidence. Another factor related to this is called Mechanical Factor such as poor vehicle maintenance, tyre blowouts, poor lights, un-roadworthy vehicles, broken down vehicles on the road without adequate warning sign and also environmental factors which includes rainfall, sun reflection, storm, heavy wind, spot holes, un-tarred roads, all these factors causes major influence of road crashes traffic in our country and its environs.

Literature Review

Data mining is the analysis of large observational data sets to find unsuspected relationships and to summarize the data in novel ways that are both understandable and useful to the user. The results of data mining are models or patterns. Data mining is an effective technique for dealing with millions or billions of data points, which is one reason it is ideal for creating a model from crash records from all over the country. Statistical methods are useful for smaller data sets, such as a few hundred to a thousand data points.

Causes of Road Crashes

Road crashes are caused due to some issues like bad road, intake of alcohol by the driver, the inexperience of the driver and some other factors. Palumbo and Rees, (2001) write on the direct and indirect factors that cause road crashes. They explained that the explosion of a pressurized vessel is the immediate cause that leads to a crash which is another condition that increased the probability of crash occurring. A wet road surface is an example of a contributing factor. Events can be defined as occurrences that happen in order to complete a task with each event arranged in a chronological order. The condition is defined as the state of the crash. He explained further that the indirect causes are the conditions that are not sufficient to cause the occurrence of a crash instead trigger the direct cause and lead the crash to occur. Indirect cause is an unsafe condition using defective equipment such as tires with bad friction, also poor lighting and distraction of the driver.

Road authorities investigating the contributing factors for road crashes have published statistical report and implemented interventions on road curves that is, crashes occur due to factors related to the vehicle surrounding environment and the driver. Shinar (2007) concurs and stated that 90% of crashes is due to driver error. This research work will determine the number of casualties involved in the crash which we base on

serious, fatal and minor, also the number of injured both serious, fatal and minor as well and the people involved adult or children.

Effect of vehicle speed on crash severity

Over speeding are the major key risk factors in road traffic collisions. Speed in traffic flow is defined as the distance covered per unit time. Because the speed of each vehicle can't be tracked, the average speed is based on a sampling of vehicles over a given period of time or area, and each produces slightly different results. Time mean speed is the arithmetic mean of speeds of vehicles passing a point. Space mean speed is the average of the speeds of vehicles on a segment of road.

Vehicle speed affects road safety in three basic ways: First, traveling at high speeds increases a driver's stopping distance, which is the distance vehicle travels while the driver reacts and the distance the vehicle travels until the effects of braking occur. This is because both the distance a driver travels when reacting as well as the distance a driver travels when braking increase at high speeds. A car traveling at 50 km/h will typically require 13 meters in which to stop, while a car traveling at 40 km/h will stop in less than 8.5 meters (Prashker, 2007). Over speeding affects safety because at high speeds, the time to adapt to changes in the environment is shorter, and the stopping distance is larger. Second, speeding reduces a driver's ability to maneuver around curves or obstructions in the roadway. Third, speed increases the crash energy exponentially. Consequently, when a vehicle is involved in a crash the higher the vehicle speed, the chance of being seriously injured or killed is much greater (Palumbo, J.P., 2001). Speed limits are designed to reflect the maximum speed considered to be safe and reasonable by the majority of drivers using the roadway under favorable conditions (Palumbo, J.P., 2001). Speed limits are based on the maximum safe speed varies due to traffic, roadway, weather, light and other conditions.

In the United States the speed limit is based on the speed used by 85 percent of drivers (the 85th percentile) while also considering other factors such as roadside development, crash experience, roadway geometrics and design speed. Unfortunately, because conditions everywhere are different, speed limits everywhere are non-uniform. Speed limits in different parts of the world have great variations even on the same road types, as climate, road conditions and traffic density are different. In Israel, the speed limits are as follows: 50 km/h on urban roads, 80 km/h on non-urban roads, 90 km/h on non-urban roads with a built-up dividing area and 110 km/h on a small number of high-speed roads.

Materials Used

In developing an accident database at the national level, efforts were made to use the technologies available that are able to assist in developing and implementing road safety programs and enable planning at both the local and national levels. The data used were formulated based on Federal Road Safety Corps, Policy, Research And Statistics Department Rs8.1 at Its Component Commands, Ilorin.

Table 1: Summary of road traffic crashes data collected for Ilorin Township and its environs

YEAR	FATAL	SERIOUS	MINOR	TOTAL CASES	NUMBER INJURED				NUMBER KILLED				PEOPLE INVOLVED								
					ADULT		CHILD		TOTAL		ADULT		CHILD		TOTAL		ADULT		CHILD		TOTAL
					MALE	FEMALE	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL			
2010	11	25	9	45	74	27	0	5	106	24	5	0	0	29	135	189	71	1	1	262	
2011	16	60	4	80	155	36	0	0	191	25	12	0	0	37	405	321	72	7	3	403	
2012	22	38	12	72	115	27	4	0	146	20	3	1	1	25	171	306	69	14	1	390	
2013	67	174	50	212	381	148	8	6	649	101	25	2	1	132	974	1182	368	41	30	1606	
2014	19	56	8	92	146	91	6	10	257	47	7	0	0	55	308	306	119	14	19	489	
2015	28	44	10	84	148	64	10	14	236	47	9	2	4	62	298	326	125	18	22	473	
TOTAL	163	397	93	585	1019	393	28	29	1585	264	61	5	6	340	2291	2650	824	95	76	3623	

The table above displays the road crashes in Ilorin Township within the year of 2010 to 2015. The table heading includes Fatal, Serious, Minor, Number Involved, Number

Killed and People Involved. Which make the total number of crashes occurred by each cases (fatal, serious, minor equal to 45), Number injured total to be 106, number killed equal to 29 while total casualty is the sum of number injured with number killed. The table shows that as the years increases the total cases increases as well as the number of people involved in the road crashes increases.

Table 2: Summary of road traffic crashes data collected for Bode Saádu and its environs

YEAR	FATAL			SERIOUS			MINOR			TOTAL CASES			NUMBER INJURED				NUMBER KILLED				TOTAL CASUALTY				PEOPLE INVOLVED			
	FATAL	SERIOUS	MINOR	TOTAL CASES	MALE	FEMALE	TOTAL	ADULT	CHILD	TOTAL	MALE	FEMALE	TOTAL	ADULT	CHILD	TOTAL	MALE	FEMALE	TOTAL	ADULT	CHILD	TOTAL	MALE	FEMALE	TOTAL	ADULT	CHILD	TOTAL
2010	4	3	14	26	79	19	0	0	0	98	6	0	6	0	0	6	125	32	4	129	125	32	4	157	125	32	4	157
2011	10	19	9	38	134	3	0	2	136	22	3	0	25	0	0	25	271	45	1	276	271	45	1	317	271	45	1	317
2012	2	16	3	21	67	6	2	0	75	14	0	0	14	0	0	14	160	6	2	166	160	6	2	168	160	6	2	168
2013	6	18	4	28	58	18	39	45	180	10	0	0	10	0	0	10	148	39	10	157	148	39	10	187	148	39	10	187
2014	6	14	3	23	70	6	0	0	76	8	1	0	9	1	0	10	102	14	0	116	102	14	0	116	102	14	0	116
2015	4	6	1	11	44	6	0	0	50	9	4	0	13	4	1	14	102	21	6	108	102	21	6	124	102	21	6	124
TOTAL	32	81	34	146	432	38	61	47	618	89	8	0	97	8	3	81	903	167	17	920	903	167	17	1080	903	167	17	1080

Table 2 displays the summary of road crashes in Bode Saadu and its environs with total cases of 26 in the year 2010. The crashes increase in the following year while decrease in the year 2013 to 2015 making the total cases to be 146 from the year 2010 to 2015. The number injured, number killed, total casualty and people involved follow the same pattern of increase in the following year and decreases in the year 2013 to 2015.

Table 3: Summary of road traffic crashes data collected for Omu-Aran and its environs

YEAR	FATAL	SERIOUS	MINOR	TOTAL CASES	NUMBER INJURED						NUMBER KILLED						PEOPLE INVOLVED					
					ADULT			CHILD			ADULT			CHILD			ADULT			CHILD		
					MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
2010	2	14	6	22	79	24	104	4	1	5	4	1	5	0	0	0	76	57	133	5	1	6
2011	12	27	8	47	88	54	142	19	3	22	19	3	22	0	0	0	289	52	341	7	1	8
2012	10	20	12	42	59	40	101	9	5	14	9	5	14	0	0	0	134	96	230	5	0	5
2013	8	30	6	44	92	21	116	14	5	19	14	5	19	0	0	0	141	55	196	2	0	2
2014	6	21	5	40	67	28	97	4	7	11	4	7	11	1	1	2	140	60	200	4	3	7
2015	8	16	1	25	70	37	117	11	4	15	11	4	15	0	0	0	97	49	146	8	14	22
TOTAL	46	128	38	220	455	204	677	61	23	84	61	23	84	1	1	2	657	368	1025	15	18	33

The above table displays the road traffic crashes data collected for Omu-Aran and its environs. Omu-Aran and its environs experienced increase in traffic carshes in the year 2011 from all the cases (total cases, total number of people injured, number of people killed, total casualty and people involved).

Table 4: Summary of road traffic crashes data collected for Offa/Erin-Ile and its environs

YEAR	FATAL	SERIOUS	MINOR	NUMBER INJURED				NUMBER KILLED				TOTAL CASUALTY	PEOPLE INVOLVED							
				ADULT		CHILD		TOTAL	MALE	FEMALE	ADULT		CHILD	TOTAL	MALE	FEMALE	ADULT	CHILD		
				MALE	FEMALE	MALE	FEMALE													
																			MALE	FEMALE
2010	4	7	6	17	16	25	8	2	51	1	8	0	0	9	60	16	25	8	2	51
2011	10	6	0	16	46	4	0	0	50	16	4	0	0	20	120	102	31	4	0	137
2012	0	11	0	11	17	6	2	0	25	0	0	0	0	0	25	10	0	0	0	10
2013	2	12	5	19	16	5	0	0	22	2	0	0	0	3	26	32	24	0	0	56
2014	4	5	2	11	20	3	1	0	24	6	4	0	0	10	34	38	12	8	0	58
2015	1	9	1	11	14	7	0	0	20	1	0	0	0	1	21	38	19	0	0	57
TOTAL	21	50	14	85	129	50	11	2	202	26	16	0	0	42	286	236	111	20	2	369

The above table is the traffic crashes data collected for Offa/Erin-Ile and its environs within the year 2010 to 2015. The total cases, total number injured, number killed by the traffic crashes in this category decreases as the year increases.

Decision

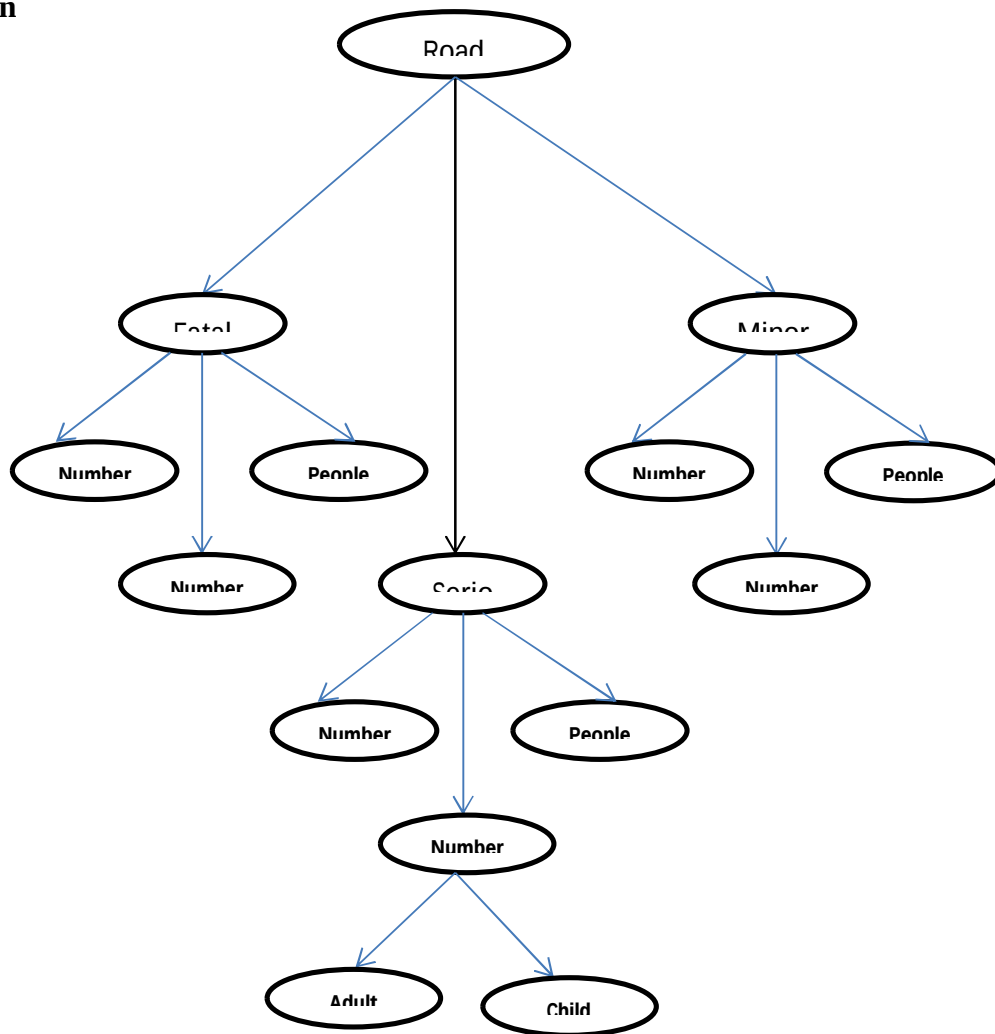


Figure 1: Tree network designed for road crashes optimization

The tree consist of three primary nodes which are (fatal, Serious and minor) with a parent node (road accident) this explains that road accident can be categorized into fatal, serious and minor, while each primary node has sub-nodes (people involved, number killed, number injured) and the number killed with sub-nodes of (adult and child). The nodes are the feed-forward network used to determine the nature of the road crash. The Number of people, the status of people involved and the nature of the accident determine the nature of the crashes.

Discussion of Result

Statistical Packages for the Social Science(SPSS) software was used to generate the output graphically from the data in the above table 1 to 4.The graphs representation of

this decision tree determines the increase or decrease of road traffic crashes in Kwara State within the year 2010 to 2015.

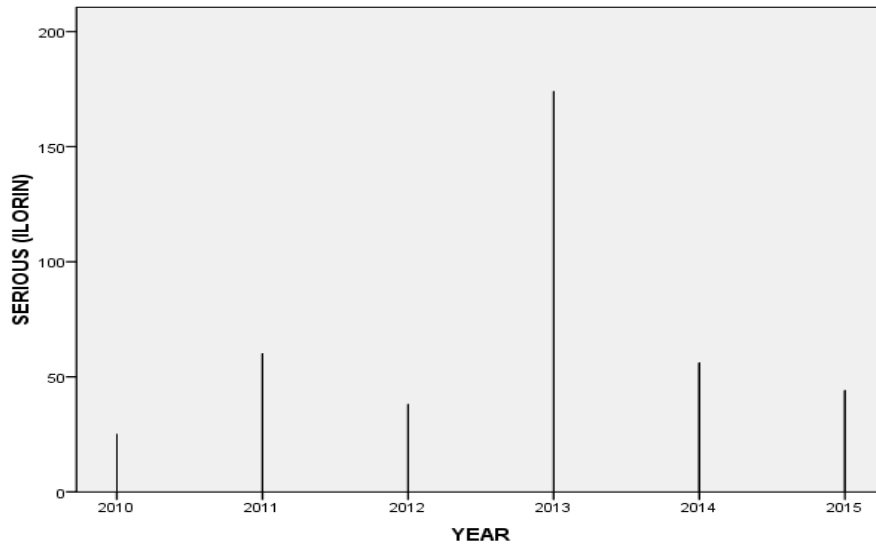


Figure 2: Histogram on Serious road traffic crashes data collected for Ilorin Township and its environs.

From the figure 2 above, it can be described that in the year 2013 Ilorin township experienced very high rate in serious road traffic crashes. The people involved in serious traffic crashes in the the year 2010 are below 50 while there are above 150 people involved in road traffic crash in year 2013.

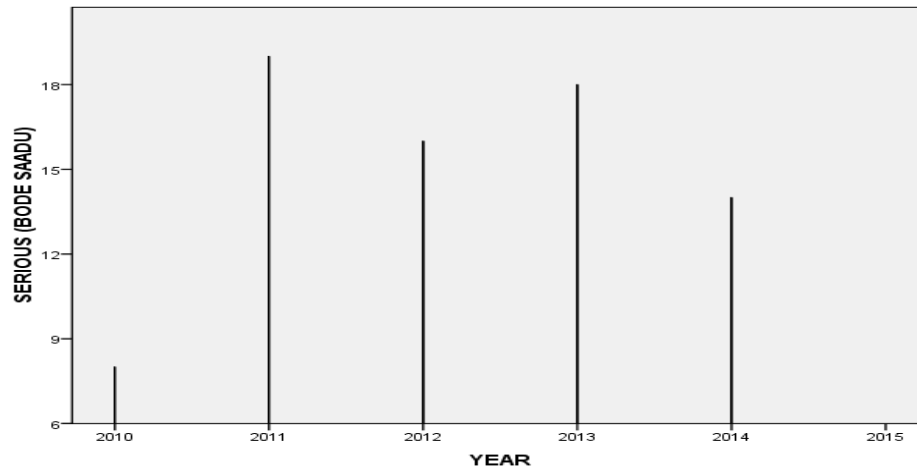


Figure 3: Histogram on serious road traffic crashes data collected for Bode saadu township and its environs.

The figure 3 above display the number of people involved in traffic crashes in bode saadu within the year 2010 to 2015 and shows that high number of people was involved in serious road traffic crash in bode saadu in the year 2011 and 2013 while no casualty involved in the year 2015 in Bode Saadu.

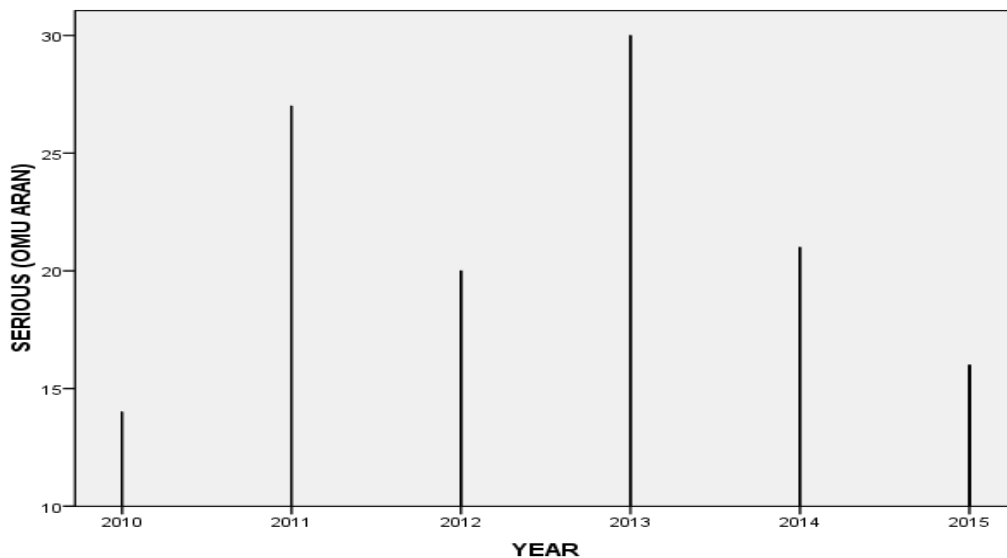


Figure 4: Histogram on serious road traffic crashes data collected for Omu-Aran Township and its environs

Omu-aran township experienced high number of people involved in serious road traffic crashes in the year 2013 and decreased in the year 2014 and 2015 respectively.

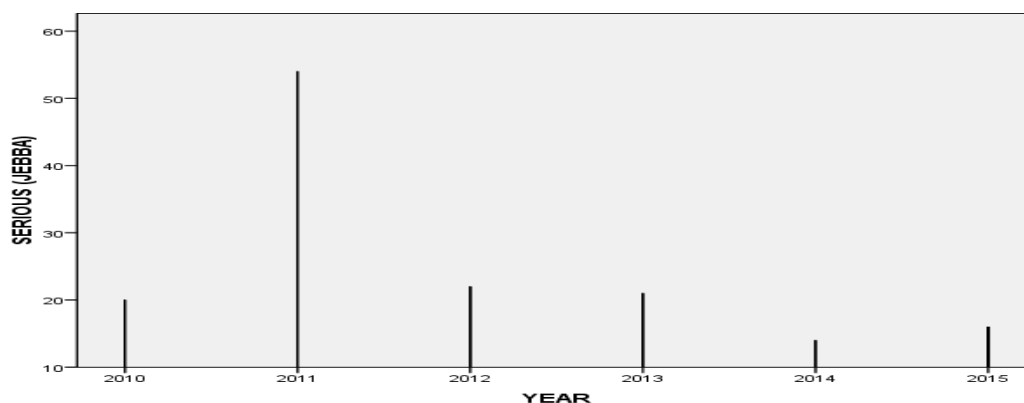


Figure5: Histogram on serious road traffic crashes data collected for Jebba township and its environs

Figure 5 displays the serious road traffic crashes in Jebba Township within the year 2010 to 2015 and have the highest serious traffic crashes in the year 2011 but decreases years after.

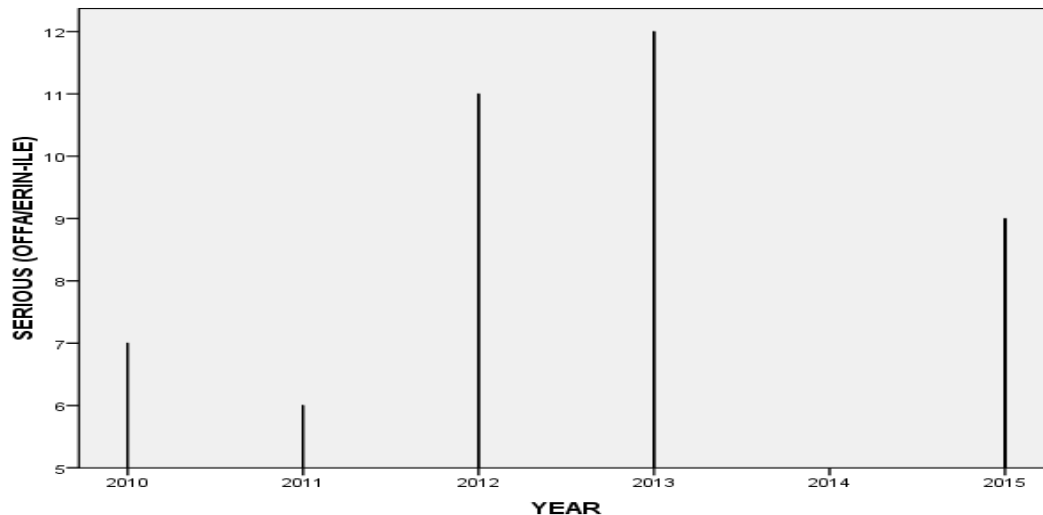


Figure6: Histogram on serious road traffic crashes data collected for Offa/ Erin-Ile Township and its environs

The figure 6 above displays serious traffic crashes for Offa/Erin-Ile township with the highest occurrences in the year 2013 followed by 2012, while no occurrence of traffic crashes in the year 2014 and year 2011 experienced the least occurrence of traffic crashes.

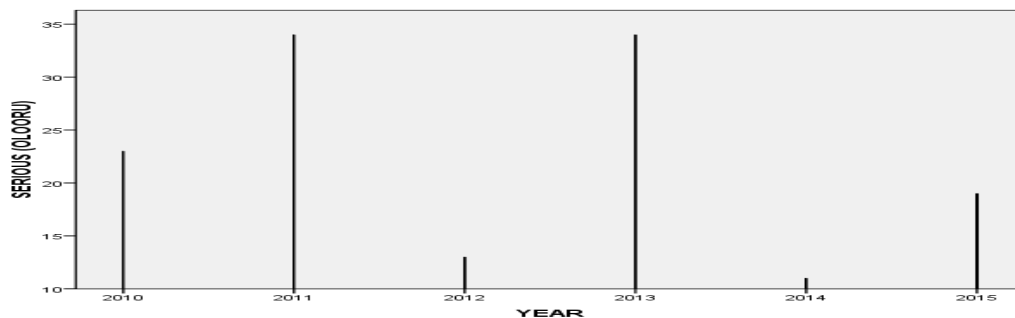


Figure7: Histogram on serious road traffic crashes data collected for Olooru Township and its environs

The figure 7 above displays the graphical analysis of serious road traffic crashes in Olooru township with the highest traffic crashes in the year 2011 and 2013 respectively while year 2014 with the least serious traffic crashes.

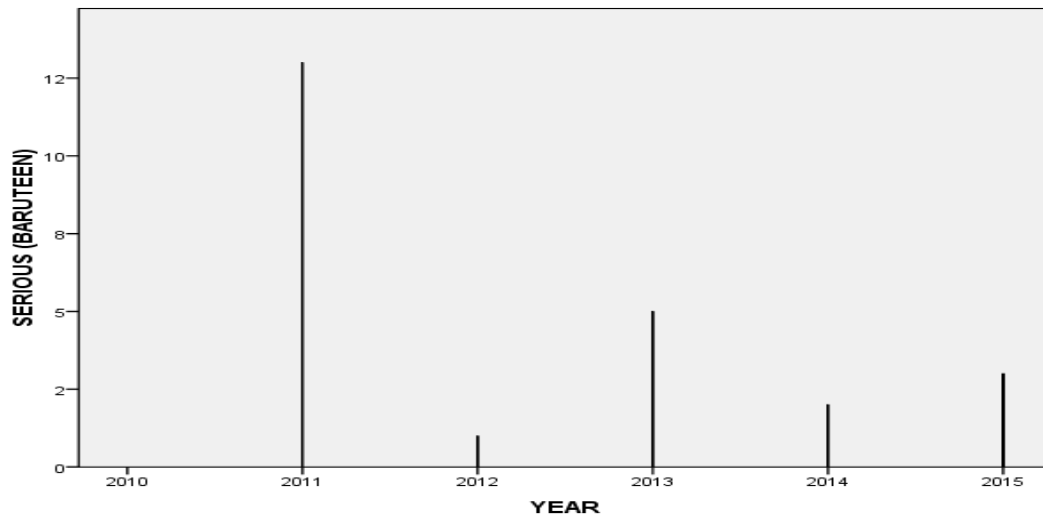


Figure8: Histogram on serious road traffic crashes data collected for Baruteen Township and its environs

The figure 8 above shows that no serious road traffic crashes occurred in the year 2010 in Baruteen while the highest traffic crashes occurred in the year 2011 and decreases in the following years.

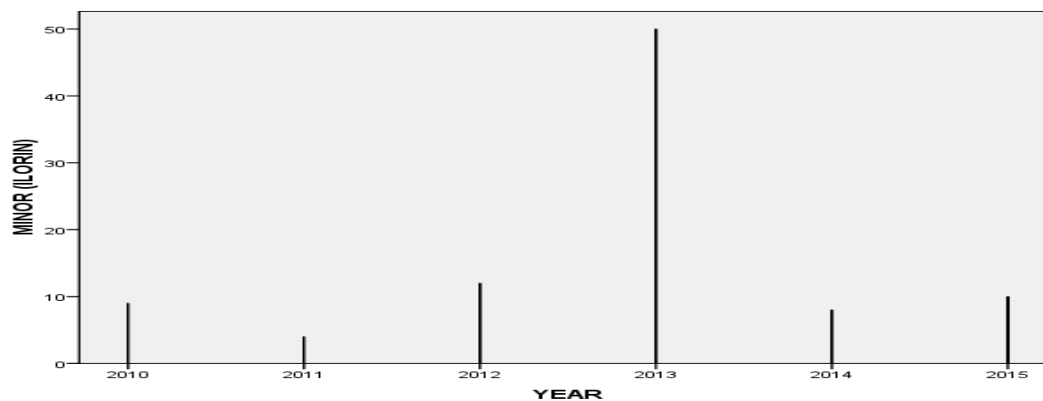


Figure 9: Histogram on minor road traffic crashes data collected for Ilorin Township and its environs.

This figure displays the series of Minor road traffic crashes occurred in Ilorin township within the year 2010 to 2015 with the highest occurrence in the year 2013 and the least occurrence in the year 2011.

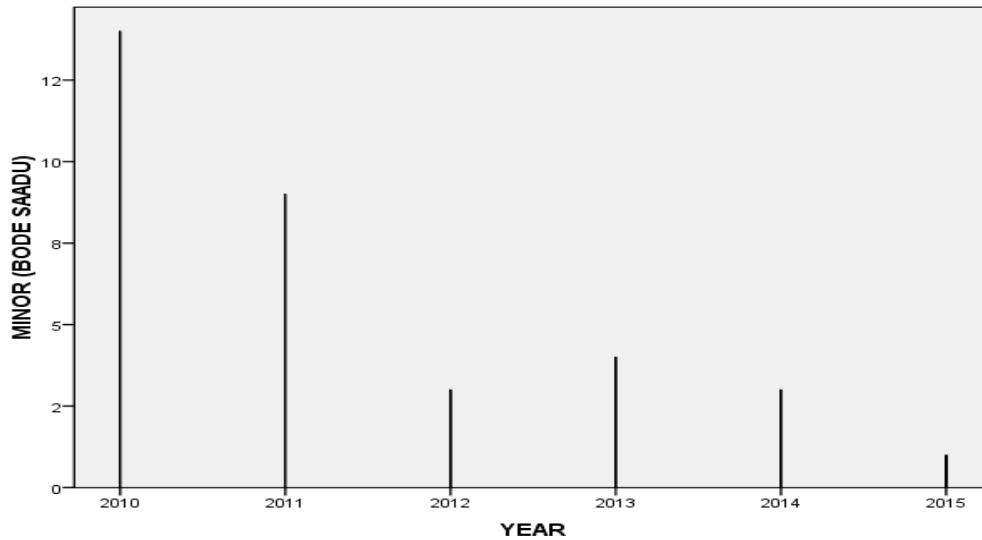


Figure 10: Histogram on minor road traffic crashes data collected for bode saadu Township and its environs

The figure 10 above displays the number of people involved in Minor traffic crashes in Bode Saadu within the year 2010 to 2015 with highest number of people were involved in minor road traffic creash in the year 2010 which later decreases in the following years.

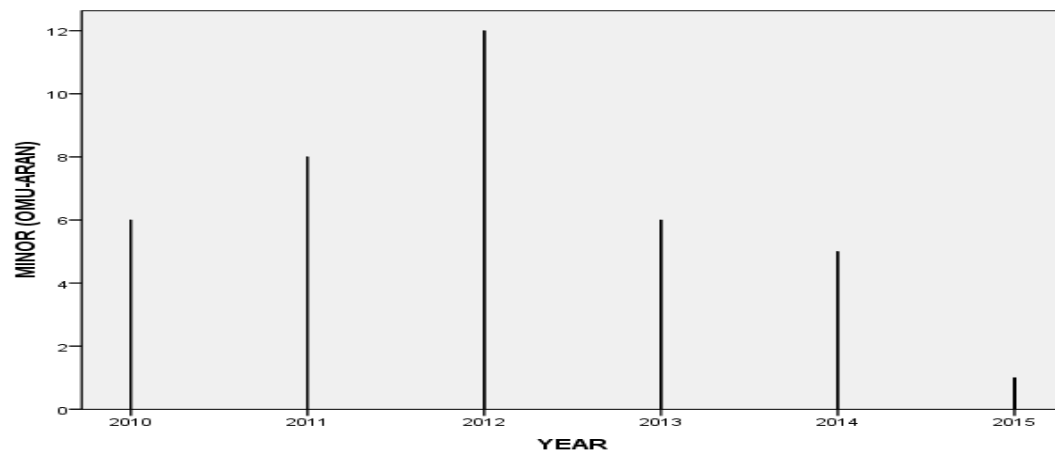


Figure 11: Histogram on minor road traffic crashes data collected for Omu-Aran township and its environs.

The figure 11 above displays the minor road traffic crashes occurrence in Omu Aran with the highest minor crashes in the year 2012 and the least occurrence in the year 2015.

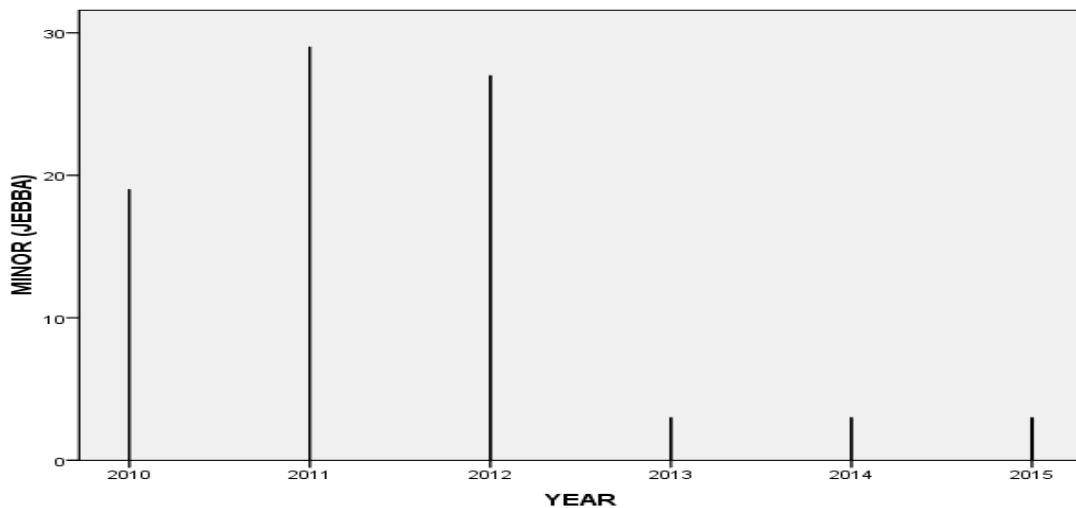


Figure 12: Histogram on minor road traffic crashes data collected for Jebba Township and its environs

Figure 12 above displays the minor road traffic crashes in Jebba township. The highest occurrence of traffic crashes occurred in the year 2011 and followed by year 2012 with a small gap between them while year 2013 to 2015 has the same number of minor traffic crashes.

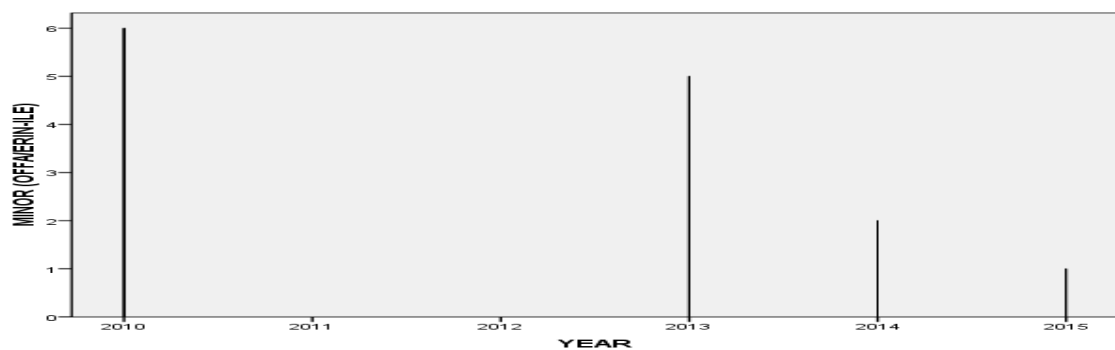


Figure 13: Histogram on minor road traffic crashes data collected for Offa/Erin-Ile Township and its environs

Figure 13 above displays the graph of Minor traffic crashes in Offa/Erin Ile township and its environs. No occurrence of minor traffic crashes in the year 2011 and 2012 while

almost 6 people were involved in minor crashes in year 2010, and decrease in the 2013 to 2015.

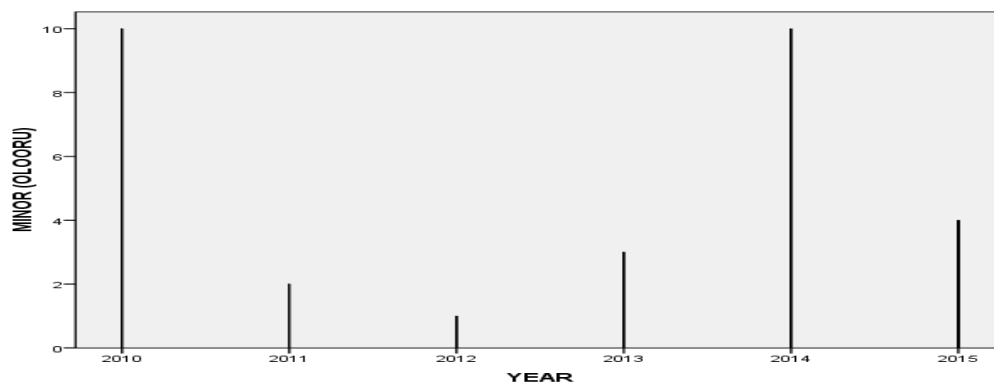


Figure 14: Histogram on minor road traffic crashes data collected for Olooru Township and its environs

The figure 14 above displays the graph of minor traffic crashes in Olooru township with the highest occurrence of minor crashes in year 2010 and 2014 respectively. While year 2012 have the least of minor traffic crashes.

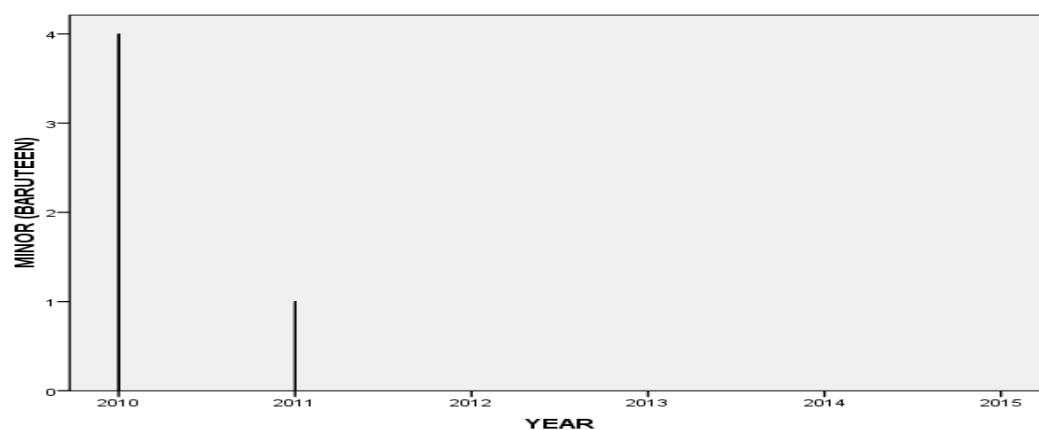


Figure 15: Histogram on minor road traffic crashes data collected for Baruteen Township and its environs

The figure 15 displays the graph of minor road traffic crashes in Baruteen and its Environs. Year 2010 have the highest occurrence of minor traffic crash follow by year 2011 while no occurrence of minor traffic crash within the year 2012 to 2015 in Baruteen township.

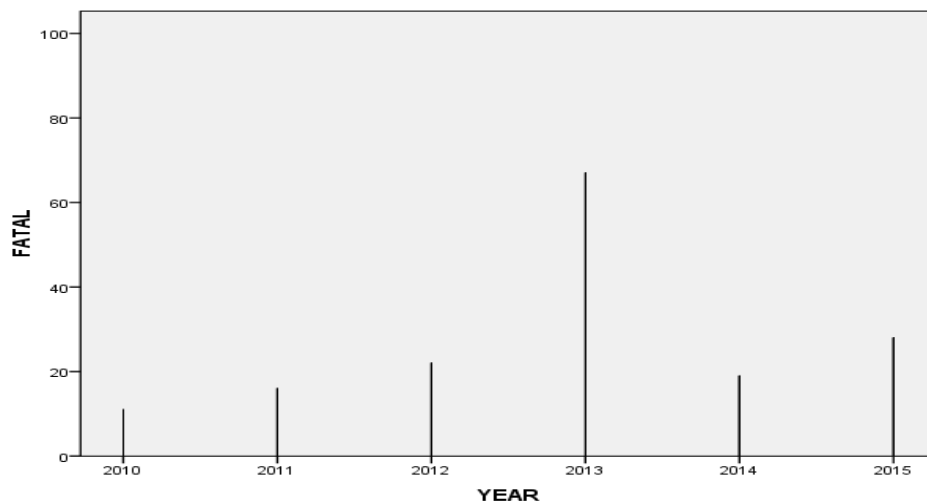


Figure 16: Histogram on fatal road traffic crashes data collected for Ilorin Township and its environs

Figure 16 displays the graph of fatal traffic crashes for Ilorin township with over 60 people involved in fatal road traffic crashes in year 2013 and the number decreases in the year before and after.

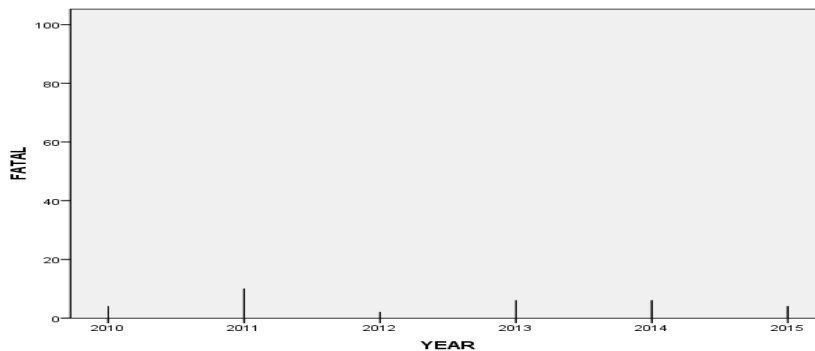


Figure 17: Histogram on fatal road traffic crashes data collected for bode saadu Township and its environs

The above figure displays the graph of fatal road traffic crashes in Bode Saadu township and its environs. The graph shows that less than 20 people were involved in fatal road traffic crashes yearly within the year 2010 to 2015.

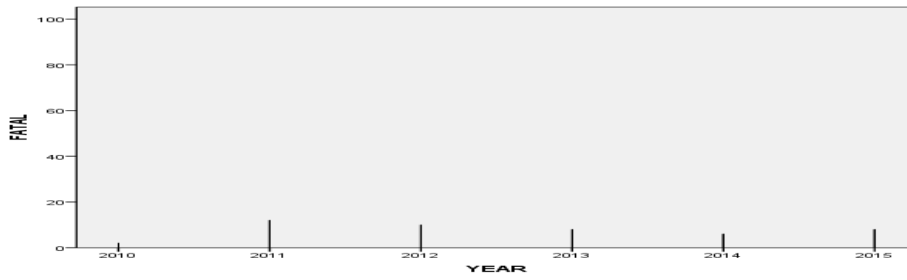


Figure 18: Histogram on fatal road traffic crashes data collected for Omu-Aran Township and its environs

The figure 18 above display the graph of fatal road traffic crashes in Omu-Aran township and its environs. The graph shows that less than 20 people were involved in fatal road traffic crashes yearly within the year 2010 to 2015.

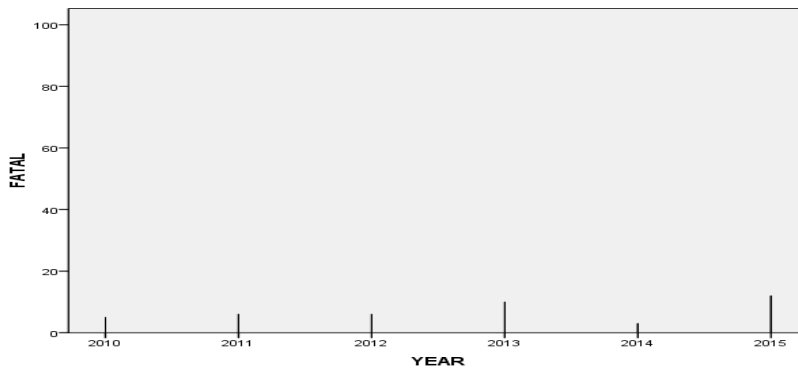


Figure 19: Histogram on fatal road traffic crashes data collected for Jebba Township and its environs

The figure 19 above displays the graph of fatal road traffic crashes in Jebba township and its environs. The graph shows that less than 20 people were involved in fatal road traffic crashes yearly within the year 2010 to 2015. Year 2013 and 2015 respectively have the highest occurrence of fatal road traffic crashes.

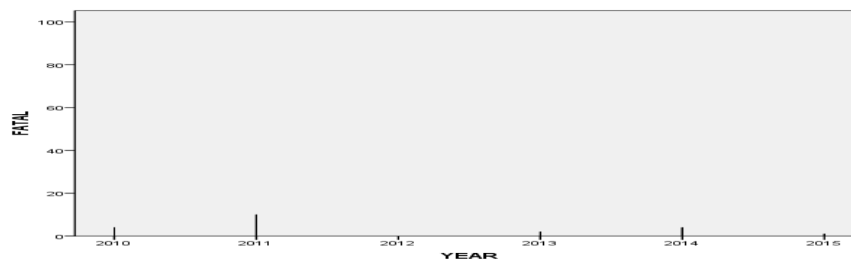


Figure 20: Histogram on fatal road traffic crashes data collected for Offa/Erin-Ile Township and its environs

The above figure displays the graph of fatal road traffic crashes in Offa/Erin-Ile township and its environs. The graph shows that less than 20 people were involved yearly in fatal road traffic crashes within the year 2010 to 2015. More so, no occurrence of fatal crashes in the year 2012 while year 2011 has the highest occurrence.

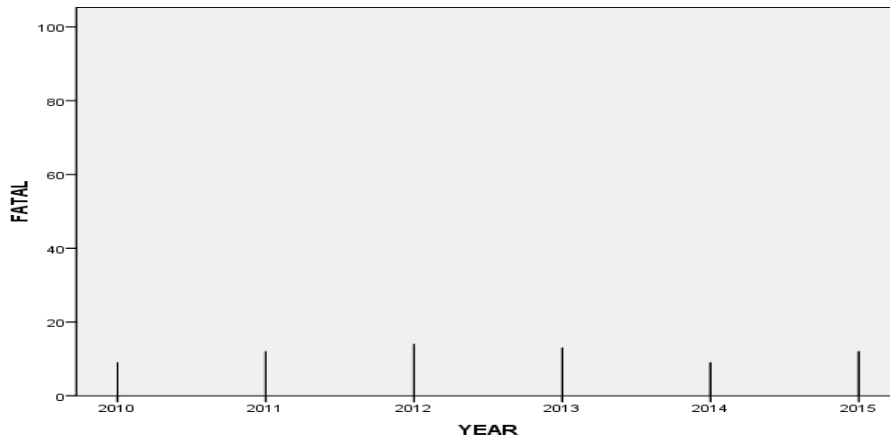


Fig. 21: Histogram on fatal road traffic crashes data collected for Olooru Township and its environs.

The above figure displays the graph of fatal road traffic crashes in Olooru township and its environs. The graph shows that less than 20 people were involved yearly in fatal road traffic crashes within the year 2010 to 2015 and the number of people involved in the fatal crashes are closely related to each other.

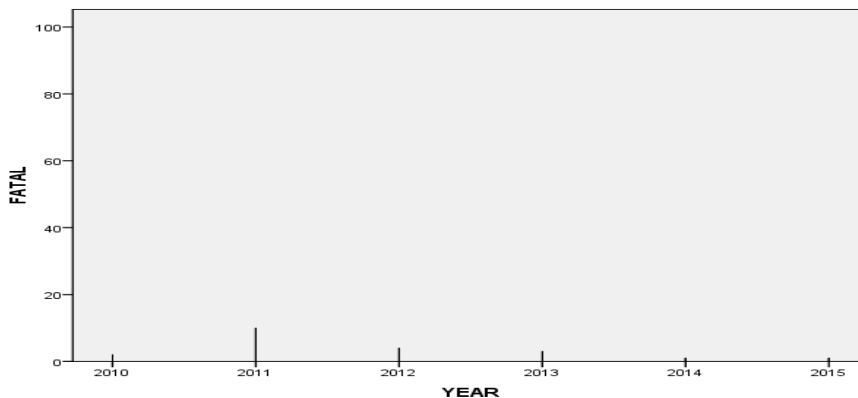


Figure 22: Histogram on fatal road traffic crashes data collected for baruteen Township and its environs

The figure 22 above displays the graph of fatal road traffic crashes in Baruteen township and its environs. The highest occurrence of road traffic crashes occurred in the year 2011. The graph also shows that less than 20 people were involved yearly in fatal road traffic crashes within the year 2010 to 2015.

Conclusion

With the result generated from the obtained data we emphasized the prevention of road crashes traffic and prevention of primary death from it due to either lack of accessible health facility or rejection by health facility. The approach to minimize road traffic accident should be multi factorial. The governments agencies responsible must enact, enforce laws and prosecute where such laws are broken. The law enforcement agent must be conscious of the fact that the money he or she may collect as bribe is not worth endangering human lives.

The models may be used for future decision making by following a similar process to that used above to improve safety at the location of crash. It is possible to evaluate a location without specific crash information, just using the infrastructure information, or to analyze a crash that occurred. The suggestions for further research stem from the limitations of this study, and the limitations of this study stem from the dataset. Firstly, there is most likely an underreported incidence of light injuries. Luckily, there were enough different types of crash scenarios in the database to build an accurate network. Adding future crash records to the existing dataset will enable future researchers to build even better models. More importantly is a need to enrich the crash records. This may be done by working together with law enforcement and bureau of statistics to collect accurate information about whether drivers were under the influence of drugs or alcohol, and seatbelt usage, especially for children passengers. Additionally, work could be done to add information about road geometry, including horizontal and vertical curvature. With these fields, new networks could be built that can be even more useful for transportation engineers.

Recommendation

With the rapid increasing popularity of the use of internet, internet is playing a crucial role of impacting knowledge and information to the final users. Discovering hidden and meaningful information about internet user usage patterns is critical to determine effective marketing strategies to optimize the Web server usage for accommodating future growth. Most of the currently available Web server analysis tools provide precisely and statistical information without real useful knowledge for internet managers. The task of mining is useful in information is becoming more challenging when the Web traffic volume is enormous and keeps on growing. In this paper, we propose an alert model to discover and analyze useful knowledge from the available

Web data. We made use of the classification information generated by a self-organizing map for pattern analysis to capture the chaotic trend to provide short-term (hourly) and long term (daily) Web traffic trend predictions like fatal accidents, seriously injured people, slightly injured people, material damage. Our traffic networks equipped with a number of measurement devices of various kinds (inductive loops, video sensors, radar detectors) that deliver real-time information about the current traffic conditions in corresponding locations. We can make use of the sensors to gather the details with the help of the GPS technology. It was collected in the data base and gathered in it. Then data was classified using the decision support systems and identify the exact decision to be given to the driver as the alert. It is one among the useful way to prevent accident rates by giving alerts to the driver. It is identified that accident rates are more at the intersections than in the highways or main roads.

The unrelenting efforts of the legislative, which sponsored a bill to amend Federal Road Safety Commission Act of 1990 is commended. The bill when amended and fully implemented will ensure that road side/mobile clinics are established to treat road crashes traffic victims free of charge. The highlights of the bill among other things include: making it an offence for any private or public hospitals to reject accident victims, all motor/motorcycles parks to be declared alcohol prohibited zones, and introduction of compulsory road traffic regulation handbook plus passenger manifest for commercial vehicles. For further study, vehicle tracking, geographical information sensor and vehicle speed limit regulator can be use as means of reducing road crashes.

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ECONOMICS OF DYNAMIC SPECTRUM ACCESS

Abdulkarim Oloyede¹, Nasir Faruk¹, Lukman
Olawoyin¹, Abubakar Abdulkarim² and
Yinusa Ademola Adediran²

¹Department of Telecommunication Science, University of Ilorin.

²Department of Electrical and Electronics Engineering, University of Ilorin.

Abstract

Dynamic Spectrum Access (DSA) was introduced to enhance spectral efficiency as a result of increasing demand for the use of the radio spectrum and to combat the inefficiencies associated with static spectrum allocation. However, it is envisaged that the DSA would result in a drop-in revenue, increase in operational costs and could lead to congestion of the network as a result of interference imposed due to secondary usage of the spectrum. Moreover, there is also a need to reduce the energy consumption of the system which could combat the climate change. This therefore, necessitates the need to examine the social-economic aspect of the DSA systems. The paper investigates the appropriateness of an auction process in DSA networks. Game theory was used to propose a model that helps solving the pricing challenges expected of an auction-based DSA network. The results presented show that, if properly implemented, the DSA can help in congestion management, increase in revenue generation, decrease in operational costs and reduction in energy consumption.

Keywords— Dynamic Spectrum Access; Game theory; Spectrum Auction; Spectrum Pricing

Introduction

The radio spectrum is a precious natural resource that lies in the electromagnetic band from 2 Hz up to 300 GHz. Across the globe, different regulatory authorities allocate different parts of the band to a range of wireless technologies. However, in the last decade, the demand for the radio spectrum is facing an unprecedented growth. This is mainly as a result of the increased number of devices seeking access to the radio spectrum. The number of devices seeking access is expected to be over 100 billion by 2020. This also translates to a tremendous increase in data traffic on the radio spectrum. The data traffic is expected to increase 100 fold by 2020 (Mukherjee, Chang, & Chien, 2015). This tremendous increase is putting some pressure on the available radio spectrum, thus, necessitating the need for efficient usage of the radio spectrum. A search to accommodate the increase in traffic has led to concepts like Cognitive Radio (CR), Licensed Shared Access (LSA), Authorised Shared Access (ASA), heterogeneous and small cell networks among others (Gad & Digham, 2010; Hoydis, Kobayashi, & Debbah, 2011; Khun-Jush, Bender, Deschamps, & Gundlach, 2012; Parcu, Nicita, Corda, Rossi, & Bravo, 2011). Most of these concepts are based on the concept of Dynamic Spectrum Access as examined in (Gad & Digham, 2010; Song, Xin, Zhao,

&Cheng, 2012). Generally, DSA allows secondary access to the radio spectrum, and the aim is to use the radio spectrum more efficiently. However, ensuring the quality of service of secondary users while satisfying the interference constraint of the primary users is the top challenge of DSA. Furthermore, for effective implementation of DSA, there is a need to use price as a regulatory mechanism. Pricing and economics principle has an important role to play because of the dynamic nature of the wireless environment (Jiang, Chen, Liu, & Ren, 2015). This is by helping to manage the traffic, examine the value obtained by the users for using the radio resources efficiently and maintaining an equilibrium in the system. Economic incentives have been used to manage vehicular traffic in congested cities around the world such as London and Paris where drivers weigh the options and consequences to either drive or use other means while travelling along the congested zones.

Energy consumption is another important aspect of DSA. There is an urgent need to reduce the amount of energy consumed by wireless networks because of its effect on climate change and to reduce the cost associated with the energy consumed. (Rehan & Grace, 2013). The cost of energy consumed forms a significant value in the operational cost of a wireless network. As the demand increases, this is also expected to increase if not properly managed. Tytgat Barrie, Gonçalves, Yaron, Moerman, Demeester, and Delaere, (2011) studied the economic balance as a result of the added cost associated with the introduction of DSA. The paper developed a model that derives the viability of spectrum sensing regarding the added cost and the reliability that comes with it. The paper concluded that the use of Wi-Fi in DSA is viable and it improves the reliability of the network while the case is not same for Zigbee. Jiang et al., (2015) examined the economics behind DSA while examining the simultaneous and sequential auction using game theory however, the paper did not examine the issue of energy usage. Sengupta and Chatterjee (2009) proposed a knapsack based auction model that allocates spectrum in a manner that maximises revenue and spectrum using game theory. The paper used price as an incentive for upgrading the network. It also showed that it is in the best interest of the Wireless Service Provider (WSP) to adhere to the price and channel threshold. Niyato and Hossain (2008) examined the economics of spectrum trading by introducing a market-equilibrium based spectrum trading mechanism. This mechanism uses the spectrum demand and supply of the primary and secondary users to estimate the price of the radio spectrum. However, the issues dealing with energy consumption was not considered in the paper. Game theory has been widely used in the analysis of conflict and cooperation between intelligent players with decisions to make. Cuzanauskas and Anskaitis (2015) described different possibilities of game theory for wireless networks. Wu, Zhang and Tsang (2011) used a Stackelberg game to study joint pricing and power allocation for DSA networks. This was achieved by using the game

to the benefit of the primary and secondary users while sharing the radio spectrum. The paper showed that primary users could benefit by selecting multiple secondary users to share their channel with, provided that mutual interference from the secondary user is limited. The paper highlighted the drawback from the interference caused by the secondary user.

This work, takes into consideration the interference from the secondary users to examine how a game model can be used in modelling the price of the energy consumed in a DSA based wireless network. The paper formulates the reasons behind an auction process and suggest why the preference for this techniques to determine the valuation of the user to maximize revenue intake of the service provider. The economic aspect of DSA is also examined because the operators of secondary wireless access face some challenges such a revenue generation, operational cost reduction, congestion management, among others. To reduce operational cost, the cost of energy used must be taking into consideration. Furthermore, the work considers a model with multiple wireless service providers(WSP) such that where we assume end users connects to any of the WSP of their choice. Based on the concept of DSA, the WSP's in this paper are assumed to be secondary users of the radio spectrum. Hence, they are constrained by the amount of interference that the primary users can endure. The main contribution of this paper is in twofold. Firstly, the paper proposes a game theoretical framework in determining the optimal price for the energy used based on the concept of DSA. Secondly, the work shows an auction process gives the best result in allocation resources with an unknown value.

Game Analysis

The proposed model, considered a game with N secondary WSP's in the system and N_f users sharing the same channel in adjacent cells. Each WSP is granting access to w secondary end users. However, for the purpose of understanding and without loss of generality, it is assume that $w = 1$ for all WSP's. Hence, we can interchangeably use WSP and user as they mean the same thing. We assume the presence of primary users in the system, however, the users in our proposed model are secondary users with fractional frequency reuse factor. Furthermore, p_i is the amount of energy resources that is consumed by user i . ($i = 1,2,3,...N$) then, energy resources consumed by all users sharing the same channel in the system is:

$$P = \sum_{i=1}^{N_f} p_i \quad p_i \in [0, \infty] \quad (1)$$

Each user has a varying level of used energy resources which is independent of any other users in the system. However, there is a maximum allowable transmit power ($p_{i_{max}}$) for any user in this system that would allow for the maximal use of the network by both the primary and the secondary users in the systems. However, a user can choose to transmit above $p_{i_{max}}$ hence the infinity in equation (1). It is assumed that there are three

components of payments made by the secondary users as demonstrated using the utility expression in equation (2): the payment per unit of energy resources consumed, the fixed price paid to the primary user for secondary access and a varying charge depending on the level of interference experienced by the primary user. The third part of the payment is introduced because, with DSA, a secondary user is not only sharing the radio spectrum with the primary user but with other secondary users in adjacent cells. Since the users are sharing a common radio spectrum, the activity of one user on the radio spectrum affects others using the same spectrum band. A selfish user transmitting with excessive transmit power diminishes a shared spectrum band for others.

In the formulated game, every user must decide how much it should pay for the energy consumed. The utility of each user is formulated as:

$$U(p_1, \dots, p_i, \dots, p_N) = p_i[s_i(p_i) - b_i] - \int_0^p c(\sum_{f=1}^{N_f} p_f dp_i) \quad (2)$$

where $s_i(p_i)$ is the expected gain of user i , for using transmitting power p_i . b_i is the unit price for the energy consumed by user i . The amount of energy consumed by the user depends on the application as each application has a varying level of transmitting power required. The transmit power required by each application is represented by P_a . When $p_i > p_{max}$, then $s_i = 0$. This means that the users are causing so much interference and rendering the system unusable. Otherwise the system is stable. Furthermore, the value of the expected gain varies from one user to the other. Hence, $s_i(p_i) \neq s_j(p_j)$. c is the cost of interference on the system and p_f is power of the interference caused by user i to users both in same cell and in adjacent cells. We assume that the WSP are granted secondary access to the radio spectrum, hence, interference to both the primary users and the other users sharing the same band in adjacent cell is of a significance. The level of interference that can be tolerated on the network varies from one user to the other. However, P_c is the level of interference that the primary user can tolerate. $P_c - P_j$ is the value of interference above P_j that the primary user can tolerate. It is assumed that the users are also charged based on the level of interference they cause to the primary user. This cost for interference is shared by all interfering secondary user. The more the number of secondary users causing interference, the lower the value paid by each user. The total interference from user i is represented as:

$$P_j = \sum_{f=1}^{N_f} p_f \quad (3)$$

For any WSP, when $p_i > p_{i_{max}}$ then the variation in expected gain caused by a single user consuming additional unit of energy is zero. That is,

$$\frac{\partial s}{\partial p} = 0 \quad (4)$$

Therefore:

$$\begin{cases} \frac{\partial c}{\partial P_j} > 0 & 0 < P_j < P_c \\ \frac{\partial c}{\partial P_j} = 0 & P_j = P_c \end{cases}$$

Also the above can be written as

$$\begin{cases} \frac{\partial c}{\partial P_j} < 0 & P_c < P_j < P_{\max} \\ \frac{\partial c}{\partial P_j} = 0 & P_{\max} \leq P_j \end{cases}$$

Where $P_{\max}$ is the maximum transmit power that allow the successful transmission at the primary and secondary users. In order to maximize the utility of the users we find the derivative of equation (2) with respect to p_i

$$\frac{\partial U_i}{\partial p_i} = s_i(b_i) - b_i + p_i S'_i(p_i) - c_i(P_j) = 0 \quad (9)$$

substituting equation (4) into equation (9), equation (10) is obtained

$$\frac{\partial U_i}{\partial p_i} = s_i(p_i) - b_i = c_i(P_j) \quad (10)$$

$$s_i(p_i) = c_i(p) + b_i \quad (11)$$

while the second derivative is

$$\frac{\partial^2 U_i}{\partial p_i^2} = - \frac{\partial c_i}{\partial P_j} \quad (12)$$

To get the optimal price, the marginal benefit must be equal to the marginal gain. Based on the equation, it can also be seen that a user in the system cannot be better off without making another user sharing same channel worse off. Hence, the equilibrium is defined as Pareto optimization. The equilibrium is Pareto because we have a non-cooperative game. The alternative would be to have a cooperative game where the users would distribute the profit. To examine the Nash equilibrium, the game can be described as:

Case 1: when derived benefit is always above the cost paid.

$$s_i(p_i) > C_i \left(p_{i_{\max}} + \sum_{f=1, f \neq i}^{N_f} p_f \right) \quad (13)$$

Hence, Case 1 optimization of equation (2) would be for the user to transmit almost at maximum power $p_i \approx p_{\max}$. This is because no matter the transmit power the derived benefit is above the cost. Therefore, in this case, the optimal value of b_i is given as

$$b_i^* = S_i p_{i_{\max}} - C_i \left(p_{i_{\max}} + \sum_{f=1, f \neq i}^{N_f} p_f \right) \quad (14)$$

Case 2: When the benefit derived is greater than the cost of interference to other users but less than the marginal cost.

$$c_i \sum_{f=1, f \neq i}^{N_f} p_f < S_i p_i < C_i \left(p_{i_{max}} + \sum_{f=1, f \neq i}^{N_f} p_f \right) \quad (15)$$

In this case, the optimal value to pay for unit of energy consumed is

$$b_i^* = S_i p_i^* - C_i \left(p_i^* + \sum_{f=1, f \neq i}^{N_f} p_f \right) \quad (16)$$

Case 3: The benefit derived is always less than the cost incurred. Therefore no matter the amount for unit of energy consumed the cost is always higher than the gain.

$$s_i(p_i) < C_i \left(p_{i_{max}} + \sum_{f=1, f \neq i}^{N_f} p_f \right) \quad (17)$$

Interference to other users is, therefore, a factor that must be taken into consideration. Hence, to maximize benefit the level of interference in the system must be carefully chosen. To maximize equation (17) all the users in the system must pick their choice of interference level that would allow for the system to be useable. We assume h_i to be the cost of unit of energy consumed by user i which is causing interference to others in same and adjacent cell.

$$U = \int c_i \left(p_i + \sum_{f=1, f \neq i}^{N_f} p_f \right) - p_i \max [-h_i, S_i(p_i)] \quad (18)$$

S_i is cost of interference which is a factor of the energy transmitted and it is also an odd function. Hence, $s_i(-p_i) = -s_i p_i$. To check for maximization we differentiate equation (18)

$$\frac{\partial U}{\partial p_i} = -c_i(P) - \max [-h_i, S_i(p_i)] = 0 \quad (19)$$

$$c_i(P) = -\max [-h_i, S_i(p_i)] \quad (20)$$

To determine the optimal value we have two scenarios

Scenario 1: The price paid by user i for an interference level is less than the expected gain for using p_i amount of energy.

$$-h_i > S_i(p_i) \quad (21)$$

In this scenario equation (21) can be simplified as

$$h_i = c_i(P) \quad (22)$$

Scenario 2: The price paid by user i for an interference level is higher than the expected gain for using p_i amount of energy

$$-h_i < S_i(p_i) \quad (23)$$

Hence,

$$h_i = -S_i(p_i) \quad (24)$$

Based on (21) to (24), the optimal price paid for acceptable inference level is

$$h_i^* = \begin{cases} C_i(p_i + \sum_{j=1, j \neq i}^n p_j, \text{ if } h_i > S_i(p_i) \\ S_i(p_i^*) \text{ if } h_i < S_i(p_i) \end{cases} \quad (25)$$

It can also be seen from equation (25) that amount a user is ready to pay depends on the category it belongs to. A user with a high level of interference requirement can accept high price provided the benefit derived is higher than cost while those who are not sensitive to high interference can accept much interference and pay less for energy usage. This shows that the Nash equilibrium satisfies the condition that marginal cost must be equal to marginal benefit. Combining all the cases, we obtain the Nash Equilibrium.

$$\sum S_i(p_i^*) + \max[-h_i, S_i(p_i^*)] > \sum c_i(P) \quad (26)$$

For the Nash equilibrium to be achieved, the cooperation of all users in the form of a coalition is required. Furthermore, to determine which category a user belongs to, having the internal knowledge of all the users is required. Hence, an auction pricing model would be appropriate. This would allow the users to express their valuation. Therefore, the use of an auction process is proposed since it removes uncertainty in the system by defining the strategy to be used by all the users and the allocation and payment procedure. This is done by assuming that the characteristics of the players are drawn from probability distribution which is a common knowledge to all users.

There are different types of auction models, the adopted one depending on a number of factors. However, based on revenue equivalent theorem, we should expect that all auction models should provide the same amount of revenue. Therefore, different auction models are examined in this paper.

Auction Model

An auction is a process where bids are taken from interested parties, and a winner is determined based on some established criteria. According to (Dictionary, 2014) "an auction involves the public sale of a good to the highest bidder". It can be used as the centralized market mechanism for allocating the radio resources. An auction usually involves a single seller and multiple buyers. This pricing scheme is quite interesting and can help to determine the appropriate market price or valuation for commodities.

In any auction process, there are three rules that must be made very clear before an auction begins which are the bidding rule, the allocation rule and the payment rule. The bidding rule informs all the potential buyers of how the bids are carried out either an open or closed bid, or if it is open, it can be increasing/decreasing auction. The allocation rule states what each bidder gets if they emerge victorious and the payment rule states the amount to be paid. These rules determine the auction schemes. Auctions can also be categorised either as single item auction or multiple item auctions. In a single item auction, only one item is up for sale while multiple items are up for sale in a

multi-item auction. An auction process is prone to sellers and buyers acting selfishly as they tend to maximise each other's benefit.

A. Auction Theory for DSA

Auction theory deals with the economics behind an auction. There are different models of auction, some of which are explained below.

First Price Sealed Bid Auction

This is a simple auction process where the highest bidder wins and pays the bid value submitted. This is usually carried out in a concealed fashion. It is widely used in wireless communication because it requires less computation complexity (Eraslan, Gozupek, & Alagoz, 2011).

Vickrey Auction

This is a kind of auction where the highest bidder is allocated the item on auction, but the highest bidder pays the price offered by the second highest bidder. Vickrey auctions are usually carried out using the sealed bid auction process. This encourages bidders to put forward bid which shows their true valuation of the radio spectrum. This method is disadvantageous if more than one winner emerges from the auction process. It also does not allow for price discovery and cannot maximise profit (it might even generate zero revenue to the auctioneer). The Vickrey auction model was adopted in (Yongle, Beibei, Liu, & Clancy, 2008) to capture the interaction between end users and spectrum brokers.

Sealed-bid Auction

In sealed bid auctions, the bids of the users are submitted in a concealed fashion. The submitted bids are then compared, and the winner emerges depending on the auction model adopted. A sealed bid auction model cannot be applied in isolation. It has to be implemented in conjunction with other models such as the first or second price auction. This auction model guards against collusion among users and it is widely used in spectrum allocations because it allows users to simultaneously submit their bids thereby reducing delay in the system (Coppinger, Smith, & Titus, 1980). This is because the delay is an important factor in any wireless communication system.

Simultaneous Ascending Auction (Dutch auction)

This method involves bidding in rounds. The auctioneer specifies the minimum bid increment, and the bidder increases their bids above the minimum increment. This method can be time-consuming. In this auction process, the buyers might resolve to the "live and let live" situation. This is where, in the early stages of the auction process when prices are low, buyers collude to allow everyone to win a band and tactically agree to stop pushing prices up.

The Reserve Price Auction

This is a type of auction that guarantees that the sellers only sell above a minimum price. If a buyer bids below the specified minimum price, the sellers can refuse to sell. The reserve price can be public or private knowledge. However, usually the reserve price is not always announced, but it must be realistic. If a realistic reserve price is not set, it could impact negatively on the auction.

Homogeneous Sealed Bid Auction

This type of auction is a multiple bid auction in which the buyers submit their bid in a vector format $(b_1, b_2, b_3, \dots, b_n)$, where each bid stands for the amount, the buyer is willing to pay for a particular commodity. The maximum total amount the bidder is willing to pay for all the commodities is the sum of $b_1, b_2, \dots, b_n$. In this type of auction, the buyer puts in a bid for different commodities such as different bands of the radio spectrum. Using this auction process, the bidder might lose some of the items it bids for and win some (Hailu & Thoyer, 2006).

Uniform Pricing Scheme

A uniform pricing scheme is an auction process where all the winning bidders pay the same amount. This scheme is popular for a multi-unit auction. In this scheme, the auctioneer might be the one to determine the clearing price that maximises the auctioneer's revenue based on the average bid submitted. This scheme can also be implemented with the winners paying an amount which is the lowest offered price of all the winning bids. This type of pricing scheme is prone to collusion among bidders and it is less fair in creating an unsettled market (Mezzetti, Pekeč, & Tsetlin, 2008).

Proposed Model with Results and Discussions

A DSA system using a sealed bid auction process and a reserve price is proposed. A sealed bid auction is combined with a reserve price because of the benefits as outlined in the previous section. The users in the system pick a satisfaction level that would satisfy their requirement based on an infrastructure-based uplink scenario. This work is based on the hexagonal cell structure with a fixed frequency reuse factor as specified in the parameters table. The channel assignment scheme is based on the least interfered channel. A session arrival according to a Poisson distribution process with arrival rate (λ) and inter-arrival described as exponential distribution is assumed. Each of the users who want to transmit at each auction round submits a sealed bid to the spectrum broker. Figure 1 shows the blocking probability of the system against the traffic load. When a utility value of above 60% is required, it can be seen that more blocking occurs in the system compared to a user satisfaction of 20 and 40 percent. Our proposed model has the least blocking probability, and this is about 50% which shows a great improvement over the work without proposed constraint threshold. The proposed model provides a better blocking probability because the users who value the spectrum more are allowed when the traffic in the system is high. Figure 2 shows the average energy consumed per

unit price against traffic load. From figure 2, it can be seen that the energy consumed increases with traffic load.

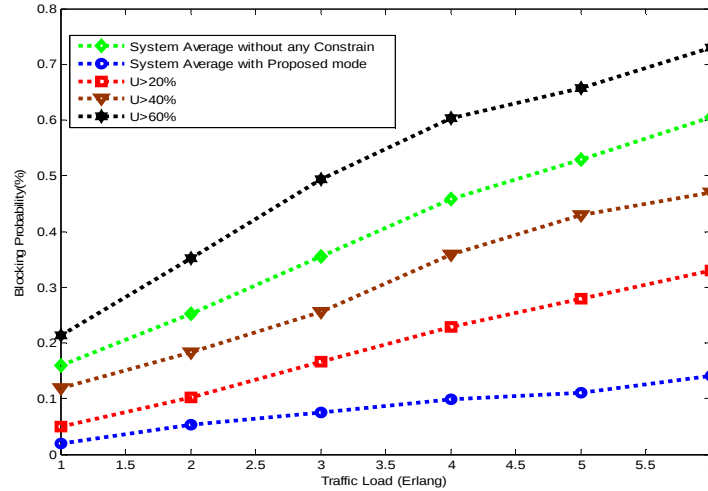


Figure 1. Blocking probability against traffic load for proposed model, without constraints and, utilities of above 20, 40 and 60%.

It can also be seen that when a target of above 60% is set as utility values for the users gives the least amount of energy consumed. This is because users without a utility value less than 60 percent are not considered.

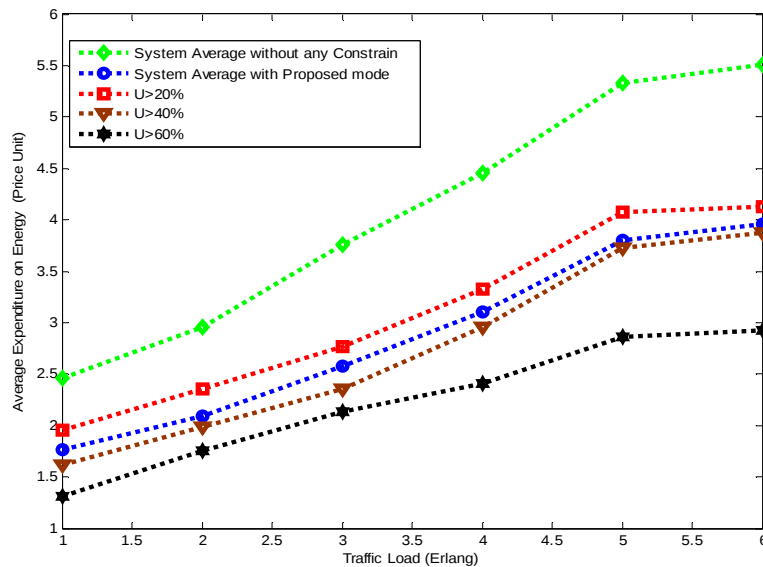


Figure 2. Average energy against traffic load

This is followed by utility value of above 40% and the reason is same. The result also shows that the proposed model performed better than a model with no constraints. Looking at this result alone, one would imagine that having a utility value set to 60% is better than values below it. However, from figure 3, it can be seen that a utility value set as high as 60 percent yields lower throughput when compared to that of 40 percent for all traffic load examined. This is also similar when the utility is set to 20% compared to that of 40%. The result also shows that the proposed model gives the best throughput possibly because the users are allowed to express themselves using the auction process.

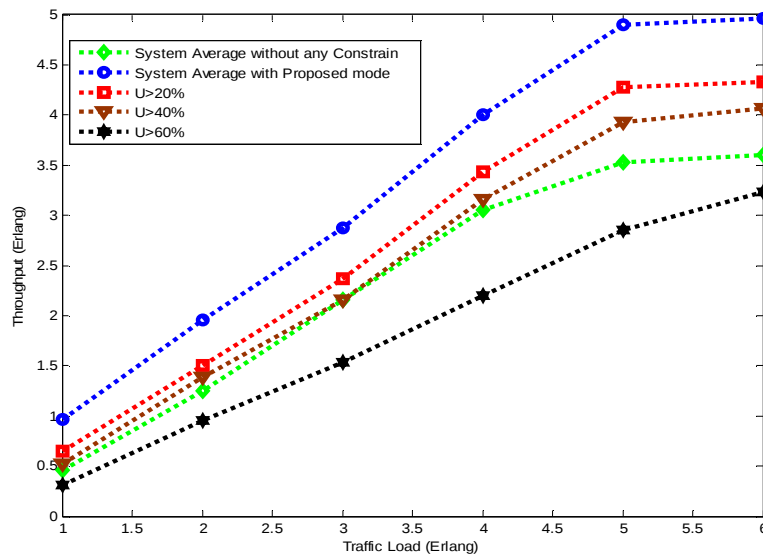


Figure 3. System throughput against traffic load

Figure 4 shows the energy saved against traffic load for the different levels of utility values. It can be seen that the proposed model gives the least amount of energy saving (numerical value should be stated) compared to when the utility value was set to 20, 40 or 60 percent. This is because the higher the utility value the better, however, more energy saving does not correspond to better throughput as seen in figure 3. This shows that energy savings is important but, this must be balanced against other system performance matrices such as the system throughput, interference cancellation. The utility value of 60 percent performs better because it sets higher requirements for the users. This is unlike the proposed model which allows for all the users to express themselves as a result of the auction process.

In order to examine the performance of the proposed model against a non DSA system, this paper compares DSA system with a system with static spectrum allocation which as shown in figure 5. The results show that for all traffic loads examined the DSA system

has a better performance. This is as expected because dynamic spectrum access allows for flexible use of the radio spectrum thereby reducing the number of failed attempts.

Figure 6 shows the dropping probability with and without DSA. It can be seen that when the traffic load in the system is low, there is no much difference between the model with DSA and the one without DSA. However as the traffic load increases, the mode with DSA performs better because, in the proposed DSA model, co-channel and adjacent channel interference are taken into consideration which is not considered in the case of static spectrum allocation.

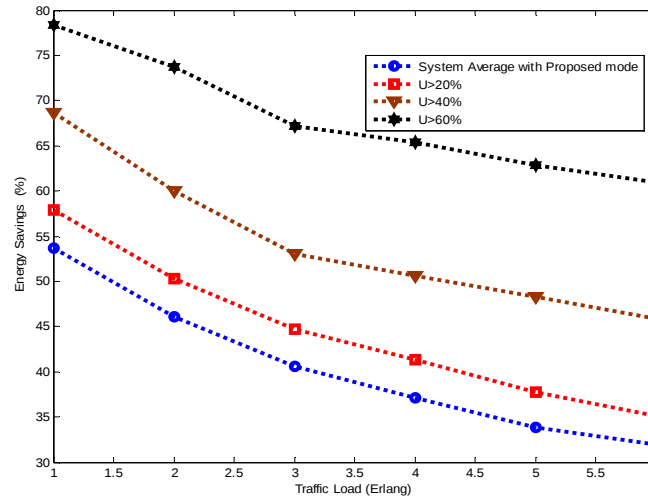


Figure 4. Overall Energy Savings against traffic load

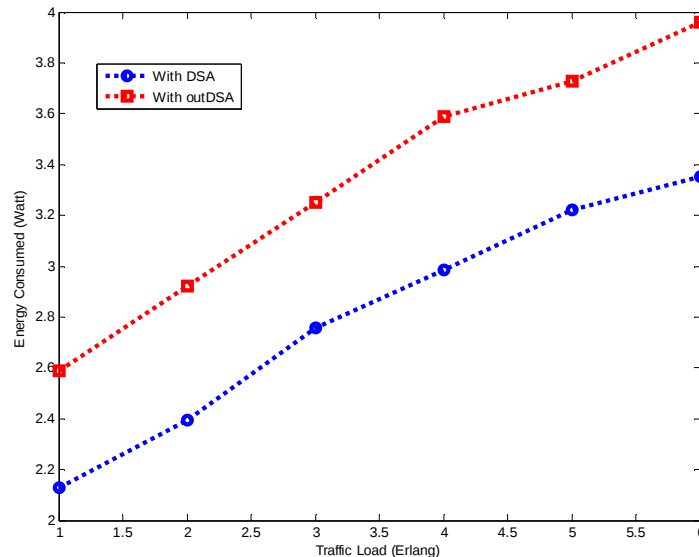


Figure 5. System Energy consumed against traffic load

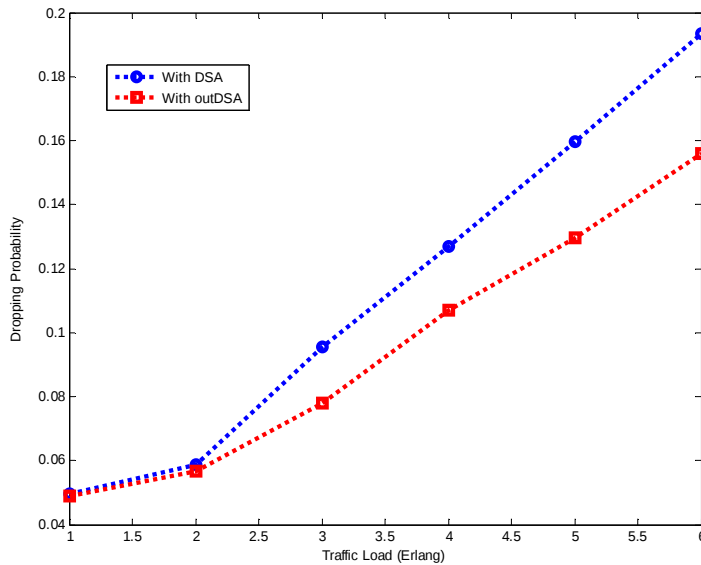


Figure 6. Overall System Throughput energy against traffic load

Conclusions

This paper has developed an economic model using an auction process based on the concept of DSA. First, it develops the utility function to express the satisfaction of the users. A game model is formulated for the WSP's to examine the Nash equilibrium. The paper shows that Nash equilibrium could only be achieved with the cooperation of all the users because no user can be better off without making others worse off. The paper has also examined different auction processes and has proposed model using sealed bid auction model. The results show that the proposed model is not necessarily the most energy efficient since other system performance metrics, such a throughput still has to be taken into consideration. The results obtained also shows that a system with DSA performs better in term of energy saving and blocking probability when compared to a system with static spectrum allocation where an auction process is not used. Future work would examine how machine learning can further aid DSA.

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HYBRIDIZATION OF EL-GAMAL AND BLOWFISH ALGORITHM FOR DATA SECURITY

*A. O. Bajeh, Y. O. Olatunde, A. G. Akintola, A. O. Balogun, M. O. Wasiu and A. T. Suleiman

Department of Computer Science
Faculty of Communication and Information Sciences
University of Ilorin, Ilorin.

*bajehamos@unilorin.edu.ng, hizyyusuf@gmail.com, abimbolar@yahoo.com,
balogun.ao1@unilorin.edu.ng, wastoy4real@gmail.com, abitao400@gmail.com

*Corresponding Author

Abstract

The internet connects all part of the world together and thus, makes it very easy and fast to communicate from different location. Reports by internet user on security issues such as hacking of E-mail account, SQL injection, unauthorized access to transactional details makes users to migrate from one platform to another. The increasing activities of hackers to overcome the existing security measures have raised the need for more and improving security technique. Therefore, this study demonstrates hybridization of Blowfish and El-Gamal algorithm to improve data security and improve the performance of El-Gamal algorithm. In the hybrid system, Blowfish is used to encrypt message containing private data using a secret key after which the secret key is encrypted by El-Gamal algorithm using public and private key which are mathematically related. The cipher text produced contains the mixture of private data and secret key. A simulation program is develop using java in order to experiment the difference between the hybrid system, blowfish and El-Gamal algorithm. The result shows that the developed hybrid system is more secure and faster compared to El-Gamal algorithm.

Keywords: Cryptography, Blowfish, El-Gamal, Algorithm, Cipher text, Encryption, Decryption

Introduction

The internet is a global network that has now become an essential (or indispensable) tool through which information are transported or shared between entities (Mossberger, 2011). It has been adopted by government, private organizations and individuals for several purposes which include dissemination of data and information among others across the world.

The volume and types of data and information that are sent or received through the internet increase on a daily basis. Such information includes sensitive matters like financial transaction, government in formation, account detail that must be kept secret away from hackers and eavesdroppers (Kaiz, 2009). It is no more news to hear of data corruption and illegal entries into systems on the internet. There are several reports of network infiltrations and cyber-attacks that are traced to political goals and nation-states (Fred, 2015).

Over the years, Cryptography is widely employed for securing data on a public network. It is a subject in the field of mathematics that is applied in computer science to ensure the security primitives. The target of cryptography is to convert data and make it incomprehensible for unauthorized user to ensure data integrity, authentication, and digital signatures (Rajan & Geeta, 2013). It involves encrypting the original information to produce “cipher text” that cannot be easily interpreted by a third party that has no key to de-cipher the encrypted text.

Symmetric cryptography and Asymmetric cryptography are mainly the two aspects of cryptography techniques shown in Figure1. Symmetric cryptographic system makes use of a single key called secret key for data encryption and decryption. In contrast, asymmetric cryptographic system is based on the application of a pair of key that are mathematically related called private and public keys for data encryption and decryption. Asymmetric cryptography poses a strong security because whoever encrypts message or perform signature verification cannot decrypt messages or create signatures. (Olatunde, Shola & Muhammed, 2017).

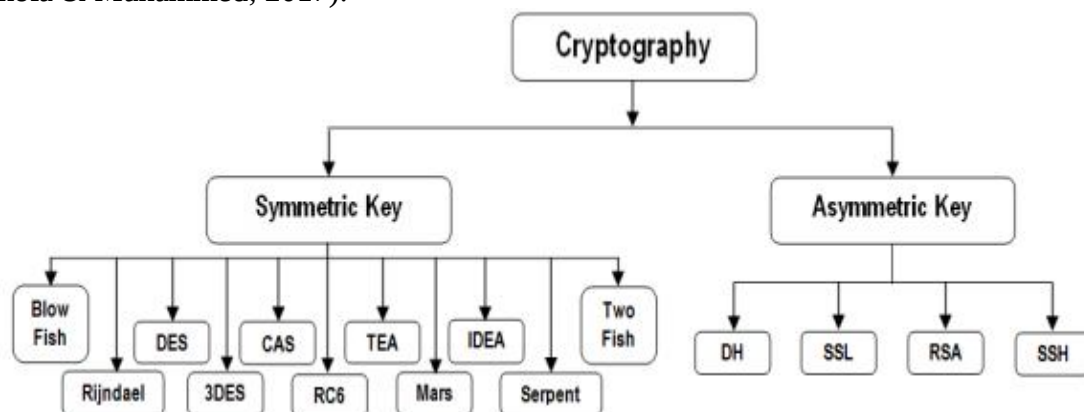


Figure 1: Different Symmetric and Asymmetric Algorithm (adopted from Kumar & Ravinder, 2012)

The main operations involved in cryptography algorithm are:

- i. Encryption: changing of text or message into cipher text or message
- ii. Decryption: the reverse of encryption
- iii. Digital signature: adding verification value to message.

2 THE ALGORITHMS

This section presents the algorithms hybridized in this study.

2.1 BLOWFISH ALGORITHM

Blowfish is one of the most popular secret key algorithm. It is a block cipher proven to have better performance compared to IDEA or DES. It uses a key length between 32 bits to 448 bits, which is to have a wide range of use. It was designed in 1993 by Bruce Schneier. It is unpatented and freely available. (Thomas & Panchami, 2015).

Blowfish Encryption Algorithm:

- Step 1: Create x as 64 bit input
- Step 2: Create i to store the number of iterations
- Step 3: Create variable xL and xR
- Step 4: $xL = x \text{ XOR } P_i$
- Step 5: $xR = F(xL) \text{ XOR } xR$
- Step 6: Exchange xL and xR
- Step 7: If $i < 16$ go to (iv) else increase i value by 1
- Step 8: Exchange xL and xR
- Step 9: $xR = xR \text{ XOR } p_{17}$
- Step 10: $xL = xL \text{ XOR } p_{18}$
- Step 11: merge xL and xR
- Step 12: End.

Blowfish Key Expansion Algorithm:

- Step 1: Create Array P with 18 3-bit subkeys
- Step 2: Create Array S-boxes with 4 32-bit values
- Step 3: Initialize S-boxes and the P-array
- Step 4: XOR P-array with the key bits. For example, P1 XOR (first 32 bits of key), P2 XOR (second 32 bits of key)...
- Step 5: Use the method in iv to encrypt the all-zero string
- Step 6: This new output is now P3 and P4
- Repeat 521 times in order to compute new sub keys for the four S-boxes and the P-array.

Blowfish Decryption Algorithm:

This is the same as the Encryption process but in the reverse order.

2.2 EL-GAMAL ALGORITHM

In 1985, Tather El-Gamal demonstrated a cryptosystem called "El-Gamal". It is one of the most secure public key encryption system. Its security rely on the (presumed) difficulty of computing discrete logs in a large prime modulus. Compare to RSA it is more secured and capable of generating random ciphertext for the same plaintext. Its drawback is that the its ciphertext is always twice the length of the plaintext. (Olatunde, Shola and Muhammed, 2017)

El-Gamal Key Generation:

In generating the pair of El-Gamal security key, the following components are required.

Step 1: Large prime number Lp

Step 2: Generator which is a primitive element Ge and cannot be any number

Step 3: A random integer Ri whereby $2 \leq Ri \leq Lp - 2$. This can be any number, it serves as the private key. It should be kept private by the user.

Step 4: Compute D such that $D \equiv Ge^{Ri} \pmod{Lp}$.

Therefore, the generated public key is (Lp, Ge, D) and private key is Ri . The public key is disclosed to unlimited number of other users.

El-Gamal Encryption Process:

In order to encrypt the secret data, the Sender B must do the following:

Step 1: Get the public key (Lp, Ge, D) from the receiver A.

Step 2: Choose an integer k such that: $2 \leq Ri \leq Lp - 2$

Step 3: Note: Represent the Secret key as an integer S where $0 < S < Lp - 1$

Step 4: Compute (Y) as follows: $Y \equiv Ge^{Ri} \pmod{Lp}$

Step 5: Compute (Z) as follows: $Z \equiv (D^{Ri} * S) \pmod{Lp}$

Step 6: The Cipher text (C) produce is: $(Y, Z) = C$

Step 7: The sender B sends C to the receiver A.

El-Gamal Decryption Process:

A pair of key is needed to decrypt the cipher text because it is encrypted using a pair of key. The decryption process is as follows: (Olatunde, Shola and Muhammed, 2017).

Step 1 Obtain the cipher text $(C = (Y, Z))$ from B.

Step 2 Compute (X) as follows: $X \equiv Y^{Lp-1-Ri} \pmod{Lp}$

Step 3 Recover the Secret as follows: $S \equiv (X * Z) \pmod{Lp}$

Report in previous research shows Blowfish algorithm possess high speed of operation and weak security strength while El-Gamal algorithm has a very high security strength but very slow performance. This motivates the hybrid system developed in this study in order to achieve a cryptosystem that is secured and consume lesser resources.

Related Work

In 2014, Christina & Joe worked on data security using Blowfish algorithm. The study emphasizes the implementation simplicity, fast and secured feature of the algorithm. In highlighting the strength of Blowfish algorithm, Rishabh & Sandeep (2014) worked on the performance analysis of cryptography algorithms. The study showed that the

performance of Blowfish is better in terms of encryption and decryption process of executables (that is, .exe) and documents (with .doc extension) file compare to AES, DESX.

Saikumar and Vasanth (2015) modify Blowfish algorithm and propose a single round of the algorithm. The simulation result obtained using Xilinx ISE with VHDL language reveals that blowfish is fast and resists several attacks. A comparative evaluation of cryptographic algorithms was done by Kumar & Ravinder (2012). In the study, El-Gamal algorithm was conclusively explained to be very strong and secure but slow in performance compared to AES and RSA. A cryptographic tool was used to perform the experiment. CPU time, used memory space, total computing time and total power were used as comparative performance metrics.

In addition, Abari, Shola and Simon (2015) in a study that compares RSA algorithm and Discrete Alogarithm using java programming language for implementation and text document for testing showed that El-Gamal algorithm is very secured explain further that El-Gamal algorithm slow performance occur during encryption and decryption process. Babatunde, Adewole, Abdulraheem and Oniyide (2014) demonstrated a network-based key exchange using El-Gamal. The study used java for implementation and it was discovered that the algorithm is highly secured by producing pseudorandom cipher text during encryption but requires double of the size of the plain text for the corresponding cipher text and it is very slow during encryption and decryption processes.

Methodology

This study uses Blowfish and El-Gamal algorithm discussed in section 2 to form a hybrid system. In the hybrid system, Blowfish is used to encrypt message containing private data using a secret key after which the secret key is encrypted by El-Gamal algorithm using public and private key which are mathematically related. The cipher text produced contains the mixture of private data and secret key. The overall process of the hybrid system is perceived by the user as an asymmetric technique rather than hybrid and this increases the level of difficulty that attackers will come across in order to have access to private data. Text document of 120kb, 216kb and 508kb are used in the experiment.

The Hybrid System Pseudo-code

- Step 1 Generate blowfish secret key denoted as F
- Step 2 Compute El-Gamal public and private key
- Step 3 Distribute the public key
- Step 4 Declare and initialize M, N and R as an empty string

Step 5	Read content of original document
Step 6	For (i =0, i <= length of document, i++)
Step 7	M = M + Encrypt character at index i (using F)
Step 8	Output M as the Secured document
Step 9	For (y =0, y <= length of F, y++)
Step 10	N = N + Encrypt character at index y (using public and private key)
Step 11	Output N as the Secured secret key
Step 12	R = M + N
Step 13	Send or receive R as the secured data
Step 14	Extract M and N from R
Step 15	Declare and initialize F and S as an empty string
Step 16	For (j =0, j <= length of N, j++)
Step 17	F = F + Decrypt character at index j (using public and private key)
Step 18	For (k =0, k <= length of M, k++)
Step 19	S = S + Decrypt character at index k (using F)
Step 20	Output S as the original document retrieved

Performance Evaluation

In this work, the performance analysis was carried out based on Encryption time, Decryption Time and Memory used.

Encryption Time: The total time a Virtual Machine (VM) or a computer takes to perform encryption of a message.

Decryption Time: The total time a Virtual Machine (VM) or a computer takes to perform decryption of a message

Memory: Memory refers to the computer hardware devices involved to store information for immediate use (primary storage) or later use in a computer. In this context, it is the total amount of storage used by a computer program to perform its operations.

Results and Discussion

Analysis of the result for Blowfish algorithm, El-Gamal algorithm and the developed hybrid method is shown in Figure 2, Figure 3 and Figure 4 respectively in terms of memory used. The portion labeled A, B, C and D;

A: the total size of the available memory (that is, total available Heap Size)

B: total memory used by the algorithm (that is, total used Heap)

C: Surviving Generators

D: Relative Time Spent in GC (Garbage Collector)

The unlabeled portion in Figure 2, Figure 3 and Figure 4 is not considered in the comparison because it denotes the number of threads and classes loaded at runtime which varies based on coding technique and professionalism of the programmer.

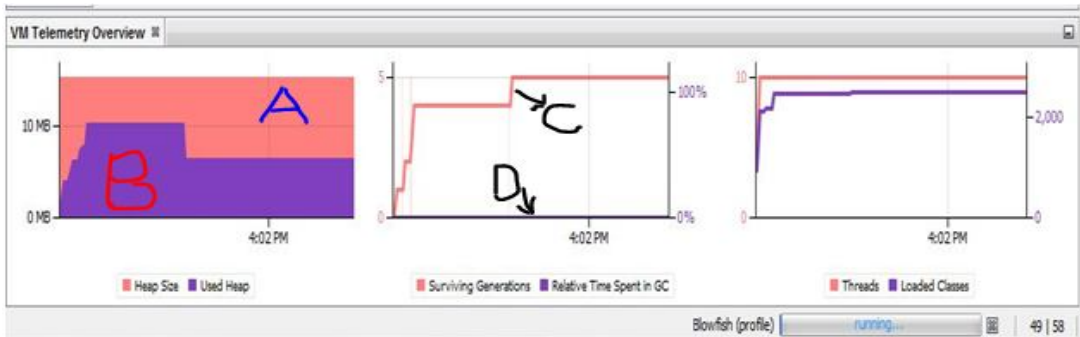


Figure 2: VM Telemetry Overview for CPU Performance of Blowfish algorithm

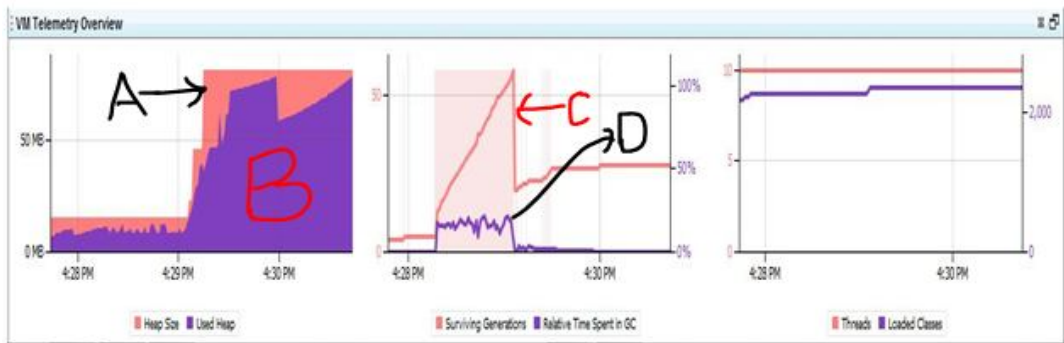


Figure 3: VM Telemetry Overview for CPU Performance in El-Gamal algorithm

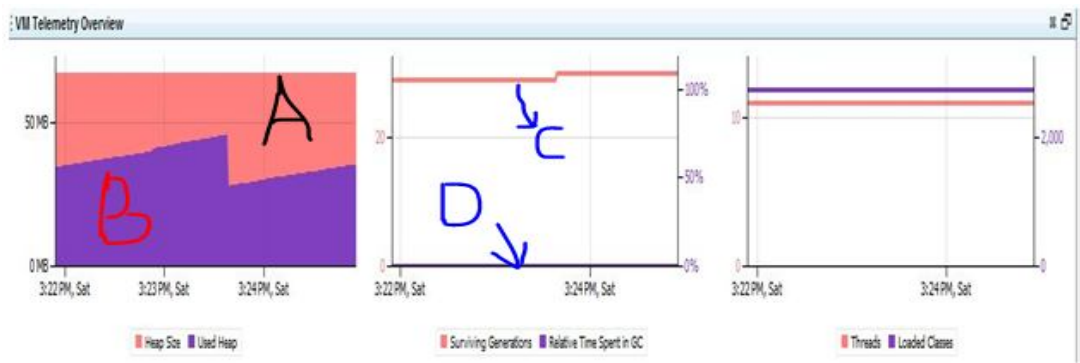


Figure 4: VM Telemetry Overview for CPU Performance in Hybrid Technique

Figure 2, 3 and 4 shows that the memory used by the hybrid system is lower compared to El-Gamal algorithm while Blowfish used the lowest memory space. In terms of

Relative Time Spent in GC, Blowfish and the hybrid technique used same amount of time which is lower compared to El-Gamal.

The comparison of Blowfish, El-Gamal and the Hybrid system in terms of encryption and decryption time is shown in Table 1.

Table 1: Comparison of Blowfish, El-Gamal and Hybrid Technique

S/N	Data Size (kb)	Algorithm	Encryption Time (Mill Sec)	Decryption Time (Mill Sec)
1	120	Blowfish	46	<1
		El-Gamal	6,084	5,351
		Hybrid	48	16
2	216	Blowfish	61	15
		El-Gamal	45,786	42,214
		Hybrid	63	32
3	508	Blowfish	63	27
		El-Gamal	4 28,143	336,508
		Hybrid	84	31
4	604	Blowfish	85	38
		El-Gamal	437,845	733,805
		Hybrid	90	67

The comparison shows that the developed hybrid system performs better than El-Gamal algorithm in all perspective. Although, this study has been able to show that there is a significant difference in the speed of operation between Blowfish, El-Gamal and the hybrid system. It should be noted that the value of encryption and decryption time in Table 1 may vary based on device configuration.

Table 2 shows comparison analysis between the mentioned algorithms based on some other attribute.

Table 2: Comparison of Blowfish, El-Gamal, Hybrid Technique based on other attribute

Attributes	Blowfish	El-Gamal	Hybrid
Date of Development	1993	1985	Proposed 2017
Key Size	32 to 448 bits	>1024 bits	Any of Blowfish and El-Gamal
Size of Block	64 bits	At least 512 bits	Any size of block in Blowfish or El-Gamal
Scalability	Scalable	Not Scalable	Scalable
Encrypt process	Fast	Very Slow	Fast
Decrypt process	Fast	Very Slow	Fast
Security	Reliable	Reliable	More Reliable
Key Used	Same	Same	Encrypted

Conclusion

One of the leading reasons for implementing an encryption-decryption scheme is privacy. As information transported through the internet, both the information and the transmission medium becomes subject to inspection and access from unofficial or unlawful individual and organization (Kaiz, 2009). In this study, encryption and decryption of plain text message was demonstrated using hybridization of Blowfish and El-Gamal algorithm. The hybrid technique provides more security and also reduces the encryption and decryption time of El-Gamal algorithm. That is, a more secured and faster algorithm is developed. In future work, comparative analysis of several hybrid techniques will be carried out based on message format in order to detect the best hybrid technique to secure message in various (text, audio, video or image) file format.

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LIBRARY USERS' PERCEPTIONS ON THE ADEQUACY OF DIGITAL REFERENCE SERVICES IN ACADEMIC LIBRARIES IN SOUTH-WEST NIGERIA

Tella, Adeyinka
Adejoro, Dolapo Tolulope,
Bamildele, Segun Sunday
Department of Library and Information Science,
University of Ilorin
&
Olaniyi, O.T
Librarian, Federal College of Education, Akoka, Lagos.

Abstract

Developments in technology have resulted in the emergence of the digital reference services to upgrade library services in order to meet the changing requirements and needs which enable users and reference librarians to communicate without physical contact. The provision of digital reference service in academic libraries is a response of librarians to the ever growing information needs and changing information seeking patterns and behaviour of patrons who are becoming less visible in the library. There is the need for libraries to maintain feedback of users' satisfaction with these services in order to extend their relevance to their users. This study evaluate the adequacy of digital reference service in satisfying users' information need from library users' perspective. This study adopted a survey design using questionnaire for data collection. A sample of 185 respondents was drawn through simple random technique from three purposively selected academic libraries in Kwara state. Descriptive statistics including simple percentage and frequency count were conducted to analyse the data. The results revealed that the quality of digital reference service provided at the academic libraries is good as the service is generally fast and easy-to-use. Generally, users' are satisfied with digital reference service provided as they considered it adequate in terms of satisfying their information need. The study concluded based on the findings that using digital reference service for reference and information service adequately satisfy users' information need. It was therefore, recommended that more academic libraries in Nigeria should digitalize their reference service so as to keep pace with advancements and users' ever changing needs.

Keywords: library users, perception, adequacy, digital reference service, online reference service, electronic reference service, academic libraries, southwest Nigeria.

Introduction

The convergence of users' information needs, social characteristics, and technological skills have always defined academic library services (Ruppel & Vecchione, 2012). Despite the processing and propagation of library resources, a key trait of academic library is the services based around personal interaction between users and the library staff (Rehman, Shafique & Mahmood, 2011). Reference and information services have

always been the main component of library services. Reference services or sometimes referred to as Reference and Information services is known as personal assistance provided by trained personnel to library users seeking information. The provision of personal assistance to users by reference librarians is the essence of reference service. They provide personalized assistance to library users in accessing suitable information resources to meet their needs. Until the internet revolution which brought about changes in the way we access information, it was the exclusive roles of the “reference librarian” to provide information directly to the client (Weddell, 2008). Reference services traditionally have been offered by a person at a designated desk within the library building, over the telephone, and through correspondence. The reference librarian handles all types of queries, from directional questions to in-depth research. The role of the reference librarian is primarily to answer patron questions and secondarily to provide readers advisory services. Reference services have been, and still is, at the heart of all libraries irrespective of their types, be it academic, public or special (Weddell, 2008).

Library services to library clients have undergone rapid transformation since the introduction of Web browsers in 1993. Consequent upon this, access to electronic information through library web pages has been proliferated and, since 1999, Web-based library reference services have emerged as vital alternatives to the traditional face-to-face (FTF) or telephone reference encounter. Synchronous, (i.e., chat reference or Ask a Librarian services) and asynchronous (i.e., e-mail) virtual reference services (VRS) have grown in number and become common features of both public and academic library home pages (Johnson, 2004). Libraries are now making sure that these services show proper levels of customer care and that the information given to the users is useful and at the right level (Loughborough University Library, 2005). Academic research is made easier for users when reference services are offered at the point-of-need, whether it is via the traditional reference desk, chat reference, e-mail, web form or text messaging reference (SMS). Thus, academic libraries have re-shaped and expand library services in order to match users with their preferred mode of communication at their point-of-need. This is especially evident in the current offerings of multiple mediums for research help and mobile-friendly web sites (Ruppel &Vecchione, 2012).

Chowdhury and Margariti (2004) were of the view that the introduction and development of the Internet and its associated Web technologies in the past decade have significantly influenced both the way libraries provide information services to their users and the way users choose to access information. Information seekers can now choose to get reference assistance in a variety of formats and, increasingly, they are turning to e-mail and chat services for the convenience of remote access and for the

extended hours of operation (Ruppel & Fagan, 2002). As a result of this, academic libraries are trying to meet the needs of the academic and research community by improving their services and enhancing their resources. Over the past two decades, academic libraries have experienced major shifts in technology. Nowadays, more and more academic libraries are developing their own websites. The emphasis has shifted from processing printed materials to providing access to information via the web (Tella & Oyegunle, 2016). One of the most significant developments in reference services these past years has been the emergence of the Digital Reference Services (Granfield & Robertson, 2008). Also known as Virtual Reference Services, Digital Reference Service (DRS) is reference service initiated electronically, often in real-time, where patrons employ computers or other Internet technology to communicate with reference staff, without being physically present (RUSA, 2004).

DRS comes in two types, namely: *asynchronous*, where a patron submits a question through e-mail and web form and the librarian responds at a later time; and, *synchronous*, where a patron communicates directly with a reference librarian in real-time using web chat applications (Granfield & Robertson, 2008). Digital reference services have emerged as viable alternatives to the traditional face-to-face (FTF) library reference encounter. Vijayakumar and Vijayakumar (2005) identified the various delivery methods of digital reference service, they include; chat reference, e-mail, web forms, SMS, social networks, knowledge base, telephone. Others include AskA services, video conferencing or webcam services, digital reference robots, library consortia, etc.

Chat reference described as "*synchronous*" refers to services where the core of the communication between the librarian and user is an exchange of text messages in real-time (Francoeur, 2006). Chat reference comes in various types, from chat using simple technologies (also known as IM reference) e.g. YahooMessenger, *Google Talk* and web-based chat rooms, to a more sophisticated technology using web contact software e.g. *Virtual Reference Software*, *24/7 Reference*, *AOL Instant Messenger* (Singh, 2004). SMS (Short Message Service) reference service involves the sending of queries as text messages from library users' mobile phones to a library phone number dedicated for this mode of reference service. User-generated text messages are converted by special communications software to e-mail and then routed to a designated e-mail account for a librarian to respond. The software converts the librarian's e-mail reply to a text message that is routed back to the user's mobile phone (Altarama 2006).

Text Messaging, also known as short-message-service (SMS), is described as “*near-synchronous*” because the sender and receiver have time to thoughtfully compose and edit a message before sending it (Guo and Turner, 2000). E-mail reference service involves user sending the library an e-mail with a reference query, supplying whatever information he or she feels is necessary. The library may reply by e-mail, phone, fax, letter, etc. Currently, the Webpages of Libraries are coming with “Ask a Librarian” option (Vijayakumar and Vijayakumar, 2005).

The provision of digital reference service in academic libraries is a response of librarians to the ever growing information needs and changing information seeking patterns and behavior of the clients who are becoming less visible in the library. A majority of today’s library clients are *Millennials*, who are characterized as technology savvy, visually oriented, multi-taskers, very demanding and expect nomadic, anytime and anywhere communication (Becker, 2009). Although the concept of offering reference service online (digital reference) has been around since the mid-1980s, when libraries first started offering e-mail reference and later libraries started using more sophisticated software that allowed them not only to chat with their users but also to fully control their users’ Web browsers (Francoeur, 2001).

Evaluation of library reference services began in earnest in the late 1960s and early 1970s when budgetary situations required justification of the existence of all services in the library. A close examination of a reference service provides library administration and involved librarians with a clear understanding of how well the service is meeting its intended goals, objectives, and outcomes, how well the service is helping users fulfill their information needs, and whether the expended resources are producing the desired results (Pomerantz, Luo & McClure, 2006). Many libraries especially the university libraries are focusing on evaluation of the users’ needs and their satisfaction with their services. User feedback is considered as a more reliable factor in measuring the utility and effectiveness of any library. This has become the reason library user surveys have become widespread in academic libraries during the past twenty years. User surveys can provide useful perceptions of service quality in libraries. Surveys have often been used as a tool to assess service quality and user satisfaction. By making user surveys a regular part of the library’s functions, librarians can provide a comparative ‘snapshot’ of usage in various temporal contexts (Rehman, Shafique & Mahmood, 2011).

There is no doubt that nowadays, every libraries are all in a bid to go digital or make their services electronically inclined in response or adapt to the ever growing information needs and changing information seeking patterns and behavior of the patrons who are becoming less visible in the library. A majority of today’s library patrons are *Millennials*, who are characterized as technology savvy, visually oriented,

multi-taskers, very demanding. They expect anytime and anywhere communication and this explains their utilization of several technologies to provide digital information and reference services to users. Thus, there is the need to regularly evaluate their processes and services in terms of how adequate they are in satisfying and meeting users' information needs. Similarly, while literature has proven that digital method of rendering reference service is worthwhile, limited studies are available generally in Nigeria and particularly among academic libraries in the South West. On this note, this study examined the adequacy of digital reference service in satisfying users' information need from users' perspective.

Objectives of the Study

The main objective of the study is to examine library users' perception on the adequacy of the digital reference services in academic libraries in Southwest Nigeria. The specific objectives are to:

1. Examine the awareness of users' on digital reference services in academic libraries.
2. Determine users' perception about digital reference services in academic libraries.
3. Examine the quality of digital reference services provided to users' in academic libraries.
4. Evaluate the adequacy of digital reference services in satisfying users' information needs.
5. Determine users' preference of digital reference services to traditional reference desk provided by academic libraries.
6. Identify the continual intention of using digital reference services in academic libraries.

Research Questions

Based on the above objectives, the following research questions were answered by the study:

1. What is the awareness of users' on digital reference services in academic libraries?
2. What is the users' perception of digital reference services in academic libraries?
3. What is the quality of digital reference services provided in academic libraries?
4. How adequate is the digital reference services provided by academic libraries in satisfying users' information needs?
5. What is the users' preference for digital reference services to traditional reference desk provided by academic libraries?
6. What is the continual intention of users using digital reference services in academic libraries?

Literature Review

Singh (2004) emphasized that libraries and librarians play an important role in providing access to information, organizing it, and helping users find the information they need. One key element of libraries has been the reference service, where librarians help users to find an information source or the information itself to meet their individual needs. Fortunately, information and communication technology (ICT), and in particular the Internet and online services, provide opportunities for enhanced reference service. Many libraries are now considering offering reference services via the internet to their users. Granfield and Robertson (2008) was of the view that, library clients prefer to access the library via the Internet and seek the help of a reference librarian in a digital environment. Thus, they prefer to use of the digital reference service over the traditional reference service being rendered. However, usage preference of the library clients may be influenced by their level of awareness on the availability and the knowledge of the features and processes involved on the existing digital reference service.

Recently the adoption of Web forms not only changed the quality of the e-mail reference engagement for the better, but also challenged librarians to develop effective means for managing questions and responses. A digital reference transaction will usually include the following elements: the user, the interface (web form; e-mail; chat; video; Voiceover Internet Protocol (VoIP), etc.), electronic resources (including electronic or CD-based resources; web resources; local digitized material etc), as well as print resources and the information professional. Vijayakumar and Vijayakumar (2005) pointed out that "Digital Reference Service, libraries Online 24/7" "virtual reference service VRS," "digital reference," "e-reference," "Internet information services," "live reference" and "real-time reference" are used interchangeably to describe reference services that utilize computer technology in some way. The e-mail reference, chat reference or an automated routing system, virtual reference is significantly influencing the delivery of high-quality library services. DRS or VRS are simply defined as the provision of real-time personal assistance to users via web-based interactive software. This service may happen when the library is closed, or when the user is unable to get to the library. With this service, users can still be in contact with experienced reference librarians. By adding interactive help to their online information services, libraries can reach users, who may never have sought out the traditional reference desk, but real online reference.

Ramos and Abrigo (2011) opined that digital reference services come in two types, namely: *asynchronous*, where a patron submits a question through e-mail and web form and the librarian responds at a later time; and, *synchronous*, where a patron communicates directly with a reference librarian in real-time using web chat applications. Voice-over-IP (VoIP), video conferencing, short messaging system (SMS),

and Instant Messaging (IM) are some of the tools used in synchronous DRS. Similarly, Afolabi (2012) buttressed the view of Ramos and Abrigo when he pointed out that digital reference service is practiced in two modes: synchronous and asynchronous. Synchronous digital reference is characterized by real-time two way communication between the enquirer (the users) and the librarians using mechanisms such as 'chat', 'instant messaging' or 'voice over IP'. With synchronous, real time technologies, typically using text, patrons click a button on a web page to exchange messages with a librarian in real time. Asynchronous digital reference is characterized by communication in one direction at a time, typically by e-mail or Web forms. It involves the use of FAQs (frequently asked questions), e-resources, which are comprised of subject guides, lists, journals, and other content, and e-mail, which may be form-based or address-based.

Altarama (2006) stated that 'this form of asynchronous service known as SMS (Short Message Service) involves the sending of queries as text messages from library users' mobile phones to a library phone number dedicated for this mode of reference service'. User-generated text messages are converted by special communications software to e-mail and then routed to a designated e-mail account for a librarian to respond. The software converts the librarian's e-mail reply to a text message that is routed back to the user's mobile phone.

Ruppel and Fagan (2002) see the benefits of chat reference as being convenient, anonymity, speed, quality of help, and no waiting in line. Pomerantz (2006) cited convenience as the most common reason users choose to use chat reference, perceive chat reference to be fast, efficient, easy to use, "always available, and accessible from any computer with Internet access, unrestricted by physical location; and users found it to be less trouble than other forms of reference service". Herman (2007) reported that implementing SMS reference allowed the library the opportunity to access students via a familiar accessible service. By adding this new technology to the reference services, users are now able to send questions and receive answers from librarians by using the text messaging facility on their mobile phones. Using Southbank Institute library as case study, it revealed that the success of the SMS reference service revolves around three key points: SMS meets our clients' needs instantly; SMS is a relevant form of communication for students; and finally, the ease of providing SMS technology.

Empirical Framework

Users' Perception of Reference Service

Relevance studies on digital reference service have been conducted on users' perception of reference service. For instance, Ruppel and Vecchione (2012) reported the findings of a survey carried out on perception of SMS reference service among 44 students of Boise State University. Of the 44 students who participated, 8 (18%) had previously used SMS reference service. Almost all of the respondents stated they would use the SMS reference service again in the future. When asked how much they liked using the SMS reference service, 40 respondents (91%) reported in the affirmative, that they either "loved it" (25%), "liked it a lot" (30%), or "liked it" (36%). In addition, 92% of the respondents reported that the staff responded "very quickly," "quickly," or "somewhat quickly". Most respondents rated the quality of help received through SMS reference positively. When asked which formats they prefer for the information the librarian provides, 73% of the respondents selected "print and online," while the remaining 27% preferred resources to be "online only". When asked how often they visit the traditional help-desk, 25 students (57%) indicated they do not usually ask for help at traditional library reference desks because the "person at the desk do not always ready to help or they look too busy". Similarly, (56%) do not usually ask for help because they do not want to "bother going to the library building."

Ramos and Abrigo (2011) conducted a survey on evaluation of the digital Reference services in selected Philippine academic libraries using 239 respondents. The findings showed that while a majority of the respondents are familiar with the existence of digital reference services, only 65 out of 189 respondents (73%) have asked help from the librarian using the Ask-a-Librarian (chat), e-mail reference, Facebook, etc. The estimate consensus ranking, from the most to the least preferred, (1) e-mail reference (3.74); (2) Ask-a-Librarian (chat) (3.32); (3) web forms (3.08); (4) Facebook library fan page (2.82); and, (5) online tutorials (2.05). They concluded that users' preference in digital reference services varies according to type of reference and information service. The results also showed that the use of digital reference services to ask questions and seek assistance from the librarian has made their research more interesting and cheaper. Similarly, the study reported that digital reference services have made their research faster and saves time and that the use of digital reference service has made reference librarians more efficient in providing reference and information service and also enable reference librarians become more approachable and helpful.

The study by Luo (2011) reported that San Jose State University survey participants used SMS for digital reference service because they needed information immediately

(55.6%), wanted to see how the service worked (38.9%), did not have Internet access (33.3%), and needed help from a librarian (16.7%). In addition, 88.9% of the participants said they would be willing to use the service again. Participants were satisfied with SMS service in terms of speed and convenience but said it is a challenge to ask a more complex question via SMS. Participants also considered texting to be a more comfortable way to get help from a librarian.

Tomaszewski (2011) reported a study conducted with science students at Georgia State University indicating that SMS communication was the second most popular method of speaking with a liaison librarian, and second only to walking into the library for assistance. The results also indicated that students preferred SMS reference because of “the convenient and unobtrusive nature of SMS which makes it more popular choice with students who own a cell phone. The study concluded that SMS is the preferred method of communicating among science students.

Peace, Collard and Whatley (2010) indicated that when a respondent using the SMS reference service texted a response back containing some form of the words “thank you,” it was an indicator of satisfaction. They found that the more transactions during an SMS reference encounter were exchanged, the more likely to be “thank you” responses. The authors stated, “When the total number of messages exchanged was four or more, a “thank you” event was received 61% of the time. Response time for transactions where a “thank you” was received, on average, was three times faster than the response time for those transactions in which no “thank you” was received.

Dehart and Viles (2007) revealed that some of the advantages of SMS include its social acceptance given students’ ready access to mobile phones and their familiarity with text messaging communication, its appeal for students having spoken language difficulties, and the ease of implementation and training for reference staff who are already capable of handling e-mail reference queries. Limitations of SMS as a viable digital reference option include a technology-imposed limit of 160 characters per text message, the availability of synchronous reference services (in-person visits to the reference desk, telephone calls, IM and chat) that can respond more readily to users’ queries, and the “text-only” nature of the medium.

Methodology

Research Design

The study adopted a survey design approach. Survey design was considered appropriate in this study as it allows for the use of questionnaire as data collection instrument from a

representative sample. Also, survey research is appropriate in assessing thoughts, opinions and feelings that cannot be directly observed.

Population

The target population in this study consists of undergraduate and postgraduate users of academic libraries in South-West region of Nigeria.

Sample and Sampling Techniques

Sample, in research, refers to that group of the study's population from which necessary data for its conduct would be obtained. In other words, it represents a smaller group of the elements or members, drawn through some definite procedure from a specified population. A preliminary survey of websites/pages of academic libraries in south-west region of Nigeria was conducted to determine those libraries currently offering digital reference service and what tools they use. As a result of this, three academic libraries were selected as subjects for this study, namely: Kenneth Dike Library, University of Ibadan; Centre for Learning Resources, Covenant University, Ota; T.Y. Danjuma Library, Ajayi Crowther University, Oyo. Sample was selected on the basis of availability of digital reference service and the visibility of this service on their university library websites/pages. A sample of 185 users was drawn through simple random technique from the three selected academic libraries, this was done at their various sections on the basis of availability and readiness of users to participate in the survey. This comprises of both undergraduates and postgraduates students from the various faculties available in each university. These 185 users represent the sample for the study.

Instrument for Data Collection

The instrument employed for data collection in this study was a questionnaire titled Digital Reference Service Perception survey. Questionnaire was used because it usually helps to gather the factual in-depth information desired, the questionnaire was closed ended. The design of the questionnaire was informed by literature reviewed, previous survey questionnaires used in similar studies and research questions. The questionnaire was divided into six sections labeled section A to F based on the objectives to be achieved in the study. Section A covered (items 1-5). The items covered the students' bio-data information (gender, academic status, year of study and age). Section B covered (items 6-10). The items covered users' awareness and perception of digital reference services- this section adopts yes/no options with list of items ticked by respondents. Section C covered (items 7-12). The items covered the quality of digital reference service provided –this provided list of items rated by respondents on a 5 point likert scale. Section D covered (items 13-19). The items covered adequacy of digital

reference service in satisfying users' information need - this provided list of items rated by respondents on a 5 point likert scale. Section E covered (items 20-27). The item covered users' preference of digital reference service – this adopts yes/no options with list of items ticked by respondents. All the items from section A-E are closed ended items except for the second part of section E that required that respondents should provide the reason for continual usage of DRS in an open ended format (see detail in Appendix 1). The response format used in section C-D follow a 5 point likert scale ranging from Strongly Agree-SA; Agree-A; Not Sure- NS; Disagree-D and Strongly Disagree-SD.

Validity of Instrument

To ensure the validity of the instrument used for data collection in this study, the questionnaire was given to two researchers with bias in the use of ICT in reference services. The instrument was modified based on the suggestions and comments by the experts. Comments and suggestions from the experts indicated that the instrument is having both face and content validity because the items actually relate to what is being measured. In addition, adaptation of items from previous related studies in part justifies the validity of the instrument.

Reliability of Instrument

To ensure the reliability of the instrument used in this study, it was administered on 20 respondents out of the envisaged population. A split half reliability method was employed and the responses gathered were subjected to Pearson Product Moment Correlation and the overall reliability of the questionnaire returned an $r = 0.70$ thereby indicating it is reliable. The reliability of the sub-scale of the questionnaire returned as follows: section A $r = 0.78$, section B $r = 0.88$, Section C $r = 0.83$, section D $r = 0.79$ and section E $r = 0.81$ respectively.

Procedure for data collection

This refers to the process by which the research instruments were administered for the purpose of data collection. The questionnaire was administered to respondents at the various sections of each library. Informed consent of the respondents was sought and they were all given voluntary opportunity to participate in the study. The exercise covered a period of four days. Responses were collected immediately from respondents. A total of one hundred and fifty nine copies of questionnaire distributed were returned properly filled. This gave a return rate of 100%. These were used for data analysis on the study.

Data Analysis Method

Data analysis method explains how the researcher intends to present, analyze and interpret data collected. Data collected from the questionnaire administration were coded and analyzed using statistical package for social sciences (SPSS) version 21.0. Descriptive statistics including simple percentage and frequency count were performed.

Presentation and Interpretation of Results

The demographic characteristics of the respondents in this study are presented as follows. The respondents were asked to indicate their demographic characteristics. This was carried out to know respondents' distribution based on gender, academic status, year of study, etc. The results are shown in Table1.

Table 1 Demographic Distribution of Respondents (N=159)

Item	Frequency	Percentage (%)
Respondents' distribution by Gender		
Male	90	56.6
Female	69	43.4
Total	159	100.0
Respondents' distribution by Academic status		
Undergraduate	145	91.2
Postgraduate	14	8.8
Total	159	100.0
Respondents' distribution by year of study (N=159)		
Year 1	14	8.9
Year 2	35	22.2
Year 3	34	21.5
Year 4	59	37.3
Year 5	5	3.2
PGDE/PGD	12	6.9
Total	159	100.0
Respondents' distribution by Age		
15-20	58	36.5
21-25	61	38.4
26-30	28	17.6
31-35	7	4.4
36-40	2	1.3
40 and above	3	1.9
Total	159	100

Table 1 indicates the distribution of students using DRS according to gender. The results show that there is a slight difference in the distribution along gender lines 56.6% for male and 43.4% for female. The academic level of the respondents revealed 91.2% are undergraduate students while 8.8% are postgraduate students. This demonstrates that undergraduate students utilize digital reference service more than their postgraduate counterpart. The undergraduate students' distribution according to their year of study shows that year 1 has 8.9%, year 2, 22.2%, year 3 21.5%, year 4, 37.3%, year 5, 3.2%, while 6.9% were postgraduate students. These findings show that there were more DRS users in year 4 than other year of study. The age distribution shows that respondents aged 15-20year were 36.5%, 21-25years 38.4%, 26-30years were 17.6%, 31-35years 4.4%, 36-40years were 1.3% while 40years and above were 1.9%. This reveals that respondents within the age bracket of 21-25years utilize digital reference service more than others. This implies that young adults are more interested in ICT based services reference services.

Research Question 1: What is the level of awareness of users' on digital reference services in academic libraries?

To answer this research question, respondents were asked if they were aware of the existence of digital reference service in their library. The results are presented in table 4.2 below;

Table 2: Awareness of DRS existence (N =159)

Item	Frequency	Percentage (%)
Yes	159	100
No	0	0
Total	159	100.0

Table 2 shows the number of respondents that are actually aware of the existence of digital reference service in their university library. The results show that the entire 100% of the respondents are aware of the existence of DRS in their university library. It is obvious here that majority of library users are aware of the existence of digital reference service in their university library.

Research Question 2: What is the users' perception of digital reference services in academic libraries? To answer research question two, respondents were asked their perception of digital reference service offer in their respective library. The results are presented in table 3.

Table 3: Users perception of digital reference service

Items	Frequency	Percentage (%)
Remote reference service provided in the library	8	5.0
Library users and librarians communicating on phone	20	12.6
The use of tools like email, chat, and social networks in answering reference queries	52	32.7
The use ICT tools to render reference services to the users	53	33.3
Communicating users via SMS and VoiceIP	26	16.4
Total	159	100

Table 3 presents the respondents' perception of digital reference service in the library. The results revealed that a total of 53 respondents representing 33.3% perceived that DRS is all about the use ICT tools to render reference services to the users. This is immediately followed by 52 respondents 32.7% who perceived that it is the use of tools like email, chat, and social networks in answering reference queries. A total of 26 respondents 16.4% perceived it as communicating users via SMS and VoiceIP, 20 respondents 12.6% were of the opinion that it is a remote reference service provided in the library.

Research Question 3: What is the quality of digital reference services provided in academic libraries? To answer research question three, respondents were asked to indicate the quality of digital reference service provided in their university library. The results are presented in table 4.

Table 4: Quality of digital reference service provided (N=159)

S/ N	Criterion Measure (Quality of DRS)	Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree	Total
1.	Fast and easy to use	74 (46.5)	67 (42.1)	13 (8.2)	5 (3.1)	0 (0)	159 (100.0)
2.	Getting Librarians' assistance is easier	44 (27.7)	88 (55.3)	16 (10.1)	10 (6.3)	1 (0.6)	159 (100.0)

			)	1)			0)
3.	Prompt Response	27 (17.0)	76 (47.8)	39 (24. 5)	14 (8.8)	3 (1.9)	159 (100. 0)
4.	Conduct of reference interview to correctly understand questions	28 (17.6)	88 (55.3)	30 (18. 9)	11 (6.9)	2 (1.3)	159 (100. 0)
5.	Answers to all questions	35 (22.0)	79 (49.7)	27 (17. 0)	17 (10.7)	1 (0.6)	159 (100. 0)
6.	Accuracy of answers	29 (18.2)	72 (45.3)	39 (24. 5)	17 (10.7)	2 (1.3)	159 (100. 0)

Note: For the interpretation of the results, strongly agree and agree were collapsed to strongly agree. Disagree and strongly disagree were collapsed to strongly disagree

The results in table 4 shows that 88.6% of the respondents strongly agree that using digital reference service for assistance is faster and easier while 3.1% strongly disagreed. Furthermore, 83% strongly agreed that getting librarians' assistance using digital reference service is easier while 6.9% disagreed. 64.8% indicated that librarians' usually give prompt response to their questions while 10.7% strongly disagreed. Also, 72.9% strongly agreed that librarians' usually conduct reference interview to understand their questions correctly but 8.2% strongly disagreed. The results also show that 71.7% indicated that they always get their questions answered using digital reference service while 11.3% strongly disagreed. Responses to accuracy of answers when they use digital reference service shows that 63.5% strongly agreed while 12% strongly disagreed. Looking at the responses to the items on the quality of digital reference service provided at each library, it is clear that the number of those who strongly agreed and agreed far outweigh those who disagreed and strongly disagreed. These results indicated generally that the quality of digital reference service provided in each university library is good. This hereby provides answer to the third research question in the study.

Adequacy of Digital Reference Service Provided

Research Question 4: How adequate is the digital reference services provided by academic libraries in satisfying users' information needs? To provide answer to research question four, respondents were asked to indicate the adequacy of digital

reference service provided at their university library in satisfying their information need using different criterion. The result is presented in table 5.

Table 5: Adequacy of digital reference service provided

S/N	Criterion measure (Adequacy of DRS)	Strongly Agree	Agree	Not sure	Disagree	Strongly Disagree	Total
1.	Answers sufficiently satisfy information need	45 (28.3)	95 (59.7)	15 (9.5)	4 (2.5)	0	159 (100.0)
2.	Referral to sources that satisfy request	45 (28.3)	91 (57.2)	17 (10.7)	6 (3.8)	0	159 (100.0)
3.	Adequate follow-up to ensure sources are helpful	16 (10.1)	65 (40.9)	44 (27.7)	28 (17.6)	6 (3.8)	159 (100.0)
4.	Digital reference service only is adequate in satisfying your information need	24 (15.1)	61 (38.4)	30 (18.9)	42 (26.4)	2 (1.3)	159 (100.0)
5.	Digital reference service provided is adequate	35 (22.0)	67 (42.1)	33 (20.8)	18 (11.3)	6 (3.8)	159 (100.0)
6.	Using digital reference service for research is effective	38 (23.9)	92 (57.9)	21 (13.2)	7 (4.4)	1 (0.6)	159 (100.0)
7.	Satisfied with the digital reference service provided	29 (18.2)	63 (39.6)	35 (22.0)	25 (15.7)	7 (4.4)	159 (100.0)

Note: For the interpretation of the results, strongly agree and agree were collapsed to strongly agree. Disagree and strongly disagree were collapsed to strongly disagree.

The results in table 5 show that 88% strongly agreed that answers they get using DRS sufficiently satisfy their information need while 2.5% disagreed. Furthermore, the

results revealed that 85.5% strongly agreed that they are always referred to sources that satisfy their request while 3.8% disagreed. A 51% strongly agreed that librarians' always follow up to know if sources they are referred to are helpful while 21.4% strongly disagreed. The result also shows that 53.5% strongly agreed that using DRS only for searches is adequate in satisfying information need while 27.7% disagreed. Similarly, 64.1% strongly agreed that DRS provided in their university library are adequate while 15.1% strongly disagreed. Furthermore, 81.8% strongly agreed that using DRS for research is effective while 5% strongly disagreed. However, 57.8% strongly agreed that they satisfied with DRS provided in their library while 20.1% disagreed. The overall result shows that the digital reference service provided in academic libraries are adequate in satisfying information need of users. This answers the fourth research question in this study.

Users' Preference of Reference Service Tools

Research Question 5: What is the users' preference for digital reference services to traditional manual reference desk provided by academic libraries? To provide answer to the fifth research question, respondents were asked to indicate their preference for either the manual/digital reference service. The results are presented in table 6.

Table 6: Users' Preference for Digital/Traditional Manual Reference Service

Items	Frequency	Percentage (%)
Traditional desk (face-to-face)	20	12.6
Chat reference (AskA Librarian)	45	28.3
E-mail reference	41	25.8
SMS reference	22	13.8
Social Networks reference (SNR)	31	21.1
Total	159	100.0

Table 6 presents users' preference for digital/traditional manual reference service. The results show that 12.6% prefer traditional desk (face-to-face), 28.3% prefer chat reference, 25.8% prefer e-mail reference, while 21.1% prefer social networks reference and 13.8% prefer SMS reference service. Chat reference, email reference, SMS reference and SNR are all digital reference services. When the responses to all of these are combines, it is clear that there is difference in the percentage of students' preference.

It is obvious that respondents prefer digital reference service to traditional reference service while at the same time, the chat reference service is more preferred to other type of digital reference service. To buttress the results above, respondents were asked to state their reasons for selecting their preferred type of reference service. The result is presented in table 7.

Table 7: Reasons for users' preference of a type of reference service

Item	Traditional	Chat reference	E-mail reference	Social Networks reference
Easy to use	2 (5)	9 (20)	8 (18.6)	6 (19.4)
Faster	6 (15)	20 (44.4)	11 (25.6)	8 (25.8)
Accessibility	8 (20)	4 (9)	6 (14)	2 (6.5)
Availability	9 (22.5)	1 (2.2)	3 (6.9)	5 (16.1)
Helpful and effective	15 (37.5)	11 (24.4)	15 (34.9)	10 (32.2)
Total	40	45	43	31

Table 7 above present respondents' reasons for preference of a type of reference service. The results show that for users' who prefer traditional desk reference; 5% opined that it's easy-to-use, 15% indicated it's faster than others, 20% opined its accessible, 22.5% opined that its always available while 37.5% think it's helpful. Furthermore, for those who prefer chat reference 20% opined that its easy-to-use, 44.4% indicated it's faster than others, 9% opined its accessible, 2.2% opined that it's always available while 24.4% indicated it's helpful. Also, for users' who prefer e-mail reference 18.6% opined that it's easy-to-use, 25.6% indicated it's faster than others, 14% opined its accessible, 6.9% opined that its always available while 34.9% indicated it's helpful. For social network reference; 19.4% opined that it's easy-to-use, 25.8% indicated it's faster than others, 6.5% opined its accessible, 16.1% opined that it's always available while 32.2% indicated it's helpful. Thus, it is obvious that users' who prefer traditional desk reference chose it majorly because it is helpful in satisfying their information need. For chat reference, it's majorly because it's faster in terms of prompt responses. Also, users prefer e-mail reference majorly because they think it's helpful as the URL's of the materials they need can be sent into their mailbox. Then, for social network reference,

they prefer it because they think it's helpful in satisfying information need as they get answers from different librarians and even other users.

To further buttress answering of the research question five, respondents were asked to specify the nature information need they would use for any of the listed reference services. The result is presented in table 8.

Table 8: Preference of Reference Service in Respect to the Nature of Information Needs

Nature of Information Need	Traditional desk	Chat reference	E-mail reference	Social Network reference	Total
Information about the library and its services	41(25.8)	57 (35.8)	28(17.6)	33(20.8)	159 (100.0)
Use of online resources, databases, OPAC, etc.	34 (21.4)	38 (23.9)	46 (28.9)	41 (25.8)	159 (100.0)
Search for materials for research, assignments, etc.	35 (22.0)	39 (24.5)	38 (23.9)	47 (29.5)	159 (100.0)
Queries	42 (26.4)	43(27.0)	25 (15.7)	49 (30.9)	159 (100.0)

Table 8 above presents users' preference for reference service in respect to the nature of information needs. The results show that users need information about the library and its services, 25.8% prefer traditional desk, chat reference 35.8%, e-mail reference 17.8% and Social network reference 20.8%. Furthermore, 21.4% prefer traditional reference, 23.9% chat reference, 28.9% prefer e-mail reference and 25.8% prefer social network reference for use of online resources, databases and OPAC. Also, 22.0% prefer traditional desk, 24.5% prefer chat reference, 23.9% prefer e-mail reference and 29.5% prefer social network reference for search for materials for research, assignments, etc. Also, 26.4% prefer traditional reference, 27.0% prefer chat reference, 15.% prefer e-mail reference while 30.9% prefer social network reference for asking queries. It is obvious from these results that users' preference in reference services varies according to type and nature of reference and information needs.

To answer research question four, respondents' were asked if they would use digital reference service again. The purpose is to know if they consider digital reference service useful or helpful to the extent of using it again. The results are presented below;

Table 9: Continual Usage of Digital Reference Service by Users'

Item	Frequency	Percentage (%)
Yes	151	95
No	8	5
Total	159	100.0

Table 8 presents digital reference service continual usage by users. The result shows that 95% of the respondents would use the service again while 5% would not. It is obvious that digital reference service is considered worthwhile for continual usage by the respondents.

In addition, respondents were asked to suggest what could be done to digital reference service that will enhance their continual usage in an open ended format. The responses that are identified include the need to recruit adequate trained and skilled reference librarians; provision of stable and good internet facilities around the school environment; organization and creation of more users' education/awareness; provision of efficient, convenient, effective, easy to use, user friendly, 24/7 digital reference service; the need to add Video conferencing to provide face-to-face communication in a digital environment; complaint system for users' to accommodate complains and other users' post should be seen; the need to provide variants of digital reference service should be provided especially social networks as it is commonly visited by users' and digital reference service planning and implementation should be based on users' needs.

Discussion of findings

With regards to the objectives of the study, this study has been able to determine users' perception of digital reference service in academic libraries, examine the quality of this service, its adequacy in satisfying users' information needs from the users' perspective and users' preference of digital reference service to traditional reference desk. This study has been able to determine users' awareness and perception of digital reference service in academic libraries. Users' awareness is evident from responses in Tables 2 where the entire respondents in the study 100% were aware of the existence of digital reference service in their university library.

In this study, DRS has made reference librarians to be more helpful, and effective. It is obvious here that DRS has made reference librarians better in one way or the other but respondents feel they have been more helpful in providing reference and information service. This supports the findings of a study conducted by Ramos and Abrigo (2011) which revealed that with the utilization of reference 2.0 services, reference librarians became more approachable and helpful. It is glaring that the use of digital reference service for searches has positive effect but they feel the use of digital reference service has made information searches faster. This again corroborates the findings by Ramos and Abrigo (2011) who reported that the use of digital reference services to ask questions and seek assistance from the reference librarian has made their research more interesting and cheaper.

It was revealed from this study that the quality of digital reference service provided in academic libraries is good. This supports the findings of Ramos and Abrigo (2011) which revealed that digital reference service provide accurate information, hence the quality of digital reference service is good.

Findings in this study also revealed that the use of digital reference service by library users' is adequate in providing answers that satisfy their information need. The overall result shows that the digital reference service provided in academic libraries is adequate in satisfying information need of users. This corroborates Ramos and Abrigo (2011) findings of a study which reported that digital reference service has become attractive to the Millennials which satisfies their information needs in cheaper, convenient and efficient ways.

Generally, as identified in this study, users' prefer digital reference services to traditional reference desk. Hence, it is obvious that users' who prefer traditional desk reference chose it because it's helpful in satisfying their information need, face-to-face communication and interpersonal relationship. This corroborates findings from Ruppel and Fagan (2002) study where participants pointed out the benefits of using (traditional) in-person reference service: personalized, direct help and face-to-face communication, speed, and high quality of help (there is always someone at the desk to help). For chat reference, users' prefer it majorly because it's faster, you get prompt response. This corroborates findings from Pomerantz (2006) in a study, which reported that, almost half (47%) perceive chat reference to be fast, efficient, easy to use. Also, Ruppel and Fagan (2002) revealed that students see the benefits of chat reference as convenience, anonymity, speed, quality of help, and no waiting in line. Furthermore, users' prefer e-mail reference majorly because they think it's helpful as materials/their URL's can be

sent into their mailbox. For social network reference, they prefer it because they think it's helpful in satisfying information need as they get answers from different people.

Findings of the study also revealed that users' preference in reference services varies according to type of reference and information service. It is obvious that users' preference in reference services varies according to type of reference and information service. This correlates findings from Ramos and Abrigo (2011) where they concluded that users' preference in digital reference services varies according to type of reference and information service based on reports from the respondents.

Findings of the study also revealed that users' consider digital reference service helpful to the extent of continual usage. This corroborates the findings of Ruppel and Vecchione (2012) where almost all of the respondents (59 out of 61) stated they would use the chat reference service again in the future.

Conclusions

Based on the evaluation of the adequacy of digital reference service in academic libraries in satisfying information need from users' perspective, it can be concluded that majority of library users' are aware of the existence of digital reference service in their university library but few utilize them, it was then discovered that users' are not well oriented of what the library can offer them, thus they prefer surfing the internet using search engines for information searches. The results revealed that the quality of digital reference service provided is good. Reference librarians readily assist users, they provide accurate answers promptly, and generally the service is fast and easy-to-use. Furthermore, using digital reference service for reference and information service adequately satisfy users' information need. Results indicated that generally users' are satisfied with digital reference service provided as it is adequate in satisfy their information need in convenient and efficient ways. Findings also revealed that users' prefer digital reference service to the traditional desk, however, it should be noted that digital reference service is not a total replacement of face-to-face reference service as users' still prefer the face-to-face communication, interpersonal relationship with reference librarians. Though, users' preference in reference services varies according to type of reference and information service and based on benefits accrued to the use of each type of reference service. In general, users' would use reference service again.

Recommendations

Based on the findings of this study, the following recommendations were made. Trained, skilled, subject expert librarians in their numbers should be in charge of digital reference service that will respond to users' promptly, have good client relation, and

follow up users to know if their needs are satisfied. Also, workshops can be organized either every semester or session to orient users' about reference service and how it assists in efficient academic performance. Digital reference service should be provided to users' at every academic library as it assists users' in their search for information for research and other purposes. It will increase users' patronage of library services and will make the library more relevant in information search even in this 21st century era. Every suggestions made by the users' earlier should be taken into cognizance in the provision of digital reference service.

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STRATEGIES FOR COSTING LIBRARY CONSULTANCY SERVICES BY INDEPENDENT CONSULTANTS IN NIGERIA

Victoria Okojie

Department of Library and Information Science
University of Abuja, Abuja, Nigeria
Email: vicokojie@yahoo.com

Abstract

This paper examines the concept of consultancy services within the library and information sector in Nigeria. In particular, the paper discusses the role of consultants, different types of consultancy that librarians engage in, the legal framework in which consultants operate and the challenges. It discusses in details three different models which a consultant may use in costing his services. The models are charging daily fee rate; charging lump sum fee rates, including an example of using the "Rational Rate" and charging per task. The paper suggests how an independent consultant can run a successful business and the need for a directory of library and information science professionals in Nigeria. The paper concludes by stressing the increasing global trend of using independent consultants. It argues that if other professionals can sustain their livelihoods through consultancies, library and information professionals can run successful consultancies by engaging in more efficient and effective costing models.

Keywords: Librarian, Consultancy services, Library and information sector, Costing, Strategies for costing, Nigeria

Introduction

Consulting is a process in which professional advisors attempt to solve challenges and issues raised by a client. Consultants could work in a consultancy firm or could be independent/self-employed and usually engage with multiple and changing clients. This implies that the clients have access to better levels of expertise than would be feasible for them to retain in-house (Bennet, 2010:81; Kinnros, 2013:5). Webster and Lorenz (1980) summarized the purpose as an outcome that is mutually beneficial to the consultant and the client stating that "with the pace of change, the dimension of many organizations, and the complexity of today's environment, greater attention has been drawn to consultants who can bring additional skills, knowledge, and experience into the library in order to facilitate change". Consultants are not employees of the company but hired to do a specific work. They are expected to do their job ethically and responsibly with minimum supervision and within a specified agreed period of time. They may work on-site and/or off-site.

Consultants usually bring measurable benefits to the system in the information age when libraries are transforming from collections to connections (Rasmussen, 2016). They may contribute to lowering the cost of operating the library system; stimulate

action and offer a response to a situation as well as add some new ingredients that may prove useful. In this case, the consultant provides impetus for action. Another benefit is that using a consultant enables the organization to concentrate its limited resources on specific aspects of the job. For instance, in capacity building for staff, the consultant comes in to do training when necessary thereby reducing the cost of maintaining a training department. Consultants assist in resolving problems, improving performance, securing action, building capacity, being a fact-finder, researcher, conflict negotiator, system designer, provide expertise in organizing library space and publicizing library services or in public relations services (Jochaumsen & Skot-Hansen, 2012, Khwaja, 2015).

Whatever the project being handled by a consultant, one of the most difficult tasks is deciding on how much to charge a client. A consultant may price himself out of the market if his rates are too high or the business may die a natural death if the charges are consistently too low. Therefore, the importance of this decision-making process has a great impact on how successful a consultant will become. This paper focuses on the legal environment in which consultancy may be operated, the challenges of consulting business as well as provides suggestions on how to calculate the consultancy fee. Career opportunities for library and information professionals and how to hire the right consultant are replete in the literature (Holt, 1984, Afolabi, 1994, Cohen and Cohen, 2003, Ard, 2006, Wiegand, 2012, Khwaja, 2017) and will not be discussed in this paper.

Types of Library Consultancy Services and Legal Framework in Nigeria

In Nigeria, the legal framework for engaging in private practice requires registration with the Corporate Affairs Commission (CAC). CAC was established by the Companies and Allied Matters Act of 1990 to regulate the formation, management and winding up of companies in Nigeria. Its services include Incorporation of companies such as Registry (Private Limited Company; Public Limited Company; Limited by guarantee); Unlimited Liability Company; Business Name; Incorporated Trustees (NGOs) and Same Day Incorporation services. The requirements for incorporation of a Company (Private or Public) are (CAC, 2017): availability and reservation of name; payment of appropriate Stamp Duty to Federal Board of Inland revenue; submission of memorandum and articles of association together with statutory forms for verification and assessment and payment of filing fees at the Corporate Affairs Commission.

Consultancy firms could be registered as a Limited Liability Company (LLC) or as a Business Name (BN). As a Limited Liability Company, the company would have a corporate name, Directors and a Share Capital. On the other hand, the BN is usually owned by an individual and requires the name of the company and the appropriate

certificate/qualification that qualifies the individual to practice as a consultant in that field. The cost, duration and requirements for registration of companies are reviewed from time to time and are usually stated on the CAC website. CAC has an online External Users Guide which provides assistance on registering companies online. Additional information on how to register a consultancy company can be found on CAC website <http://www.cacnigeria.org> or by sending a mail to cservice@cac.gov.ng. The main advantage of registration of a consultancy company is that the consultant is taken more seriously as a business concern and government and international agencies are likely to deal more with such companies.

Vassilakaki and Moniarou-Papaconstantinou (2015) and Massis (2014) stressed the emerging roles of library and information services (LIS) professionals and the need for libraries to be more business-like in their operations. The most common consultancies undertaken by LIS professionals in Nigeria include:

- Establishment of a library/resource centre from the scratch (e-library or hybrid or manual)
- Re-engineering existing aspects of library services such as automating circulation services
- Implementing new technologies such as a new library management software
- Training/Continuing Professional Development programmes such as “Use of Internet Resources in LIS Services”
- Evaluation of existing services such as reference services, analysis of the collection
- Acquisition of books, equipment and furniture
- Cataloguing, classification and indexing of materials
- Creation of library database, portal, gateway or federated search facility
- Design of Website and creation of Listserv, social networks and other discussion groups
- Development of Institutional Repositories, Electronic Thesis and Dissertations (ETDs), Open Source Systems
- Editorial work & Report Writing
- Publishing and Book sales
- Consolidation of materials especially local publications
- Book indexing, including surveys of users, community, etc
- Knowledge Management
- Solicit donation/low cost books, computers, etc

- Proposal writing, Grant seeking & Fundraising – Private-Public Partnership such as to record local history
- Project Management
- Conflict Resolution, especially between management & staff; and to improve communication
- Recruitment

In summary, the roles of library and information services consultants include: technical adviser; organizational problem-solver; education and training; process counselor and providing an objective assessment of situation.

Costing Consultant's Services

Costing consultants services is a very fluid aspect of an independent consultant's work. The ability to do a proper cost-benefit analysis will determine the level of success or otherwise of the consultant. This is because the fee charged for consultancies is not usually fixed but is dependent on such factors as the nature of the work, the amount of time/effort to be spent, the experience, the skill and expertise, the reputation of the consultant, the relationship between the client and the consultant, the nature of the client/how 'rich' the client is, the "opportunity cost" to the consultant and risk factors and the market rate which requires the consultant to do an environmental sectoral scan.

Often times, the question raised by independent consultants is 'how much do I charge?' Should it be a daily/hourly fee rate or should the fee be charged for each task performed or should a lump sum fee be charged without a breakdown of the services? Whatever method is adopted, the consultant must be knowledgeable enough to ensure that ALL his costs are covered and that he makes a profit from all jobs. The consultant must have at the back of his mind that on the average, he works about 50% of the year; therefore, he must strive to cover part of the cost of the remaining 50% from each job undertaken. There are many models used in charging consultancy services. This paper discusses three models: charging daily rates; charging lump sum and charging per task. An example using Juillet's (1989) fourth model: "The Rational Rate" is also discussed as a part of charging daily rates.

Charging Daily/Hourly Rates

Daily rates may be difficult to arrive at but it is a method that is commonly used. The consultant must remember to charge, for instance, for days he will use in writing the report; writing the proposal and factor in the cost of word-processing, printing, telecommunication, use of other experts and transportation, in addition to the main tasks. The tendency, usually, is to undercharge the client. If, however, a consultant decides to

charge a daily rate, he should find out the market rate that matches his experience, skills and qualifications. Many international organizations such as the British Council and the World Bank have standard daily rates for different categories of consultants (First Degree, Master's Degree, PhD, Professor); this will give the consultant an idea of how to charge his client. For instance, as at 2017, a professor with experience was paid an average of USD\$50-\$150 per day by local organizations while top level international organizations pay about USD\$400-\$600 per day. The actual amount paid will depend on individual bargaining power, duration of consultancy, organization's rate and so on. Juillet (1989) suggests a more scientific approach stating that a consultants' daily billing rate could be calculated as: daily billing rate = daily labour rate + daily overhead rate + daily profit. He expounds this in his fourth model: "the Rational Rate". Based on this formula, a consultancy rate cost calculator was developed (TechScribe, 2007 and Penn, 2017) that could inform the principle of costing consultancy services in general terms. An example of how the calculator could be used to determine what to charge a client in Nigeria is shown below:

- A. Weekdays = 365 days - 104 days (weekends) = 261 days
- B. Other non-working days (items iv. and v. as proposed by Juillet, 1989):
 - i. Annual leave = 30 days
 - ii. Public holidays = 12 days
 - iii. Casual/Sick leave = 7 days
 - iv. General administration to manage the office (eg to pay bills) @ 2days a month= 24 days*
 - v. Marketing and business development (eg writing proposals) @ 3 days a month= 36 days*
- Total Non-Working days = 109 days
- C. Billable days = A – B = 261 – 109 = 152 days
- D. Cost of running the business = N1,694,000 (the estimated cost should be replaced with actual costs because, for instance, it is assumed that there are no other staff):

S/N	Item	Estimated Cost per Annum
1.	Furniture & Equipment maintenance	50,000
2.	Rent	300,000
3.	Utilities, including fueling generator	300,000
4.	Telephone & Internet	120,000
5.	Stationery, including printer toners, paper, etc	120,000
6.	Printing	80,000

7.	Transportation & Travel	200,000
8.	Professional Activities such as Association dues, publications, seminars, etc	100,000
9.	Marketing & Entertainment	50,000
10.	Postage	50,000
11.	Accounting/Legal Fees	20,000
12.	Taxes	150,000
13.	Other costs (@10% of total cost)	154,000
	Total	1,694,000

E. Daily Overhead = $D/C = 1,694,000/152 = N11,145$

F. Target Salary (depends on experience, qualifications, etc of consultant) = N3,600,000

G. Daily Labour Rate = Target Salary/Billable days or $F/C = 3,600,000/152 = N23,684$

H. Daily Overhead Profit Margin (20%-30% allowed) = 20% or 0.2 (see: www.freelanceuk.com/running_buisness/price_for_profit.shtml)

I. Daily Profit = {Overhead + labour (E + G)} x Profit Margin
 $11,145 + 23,684 = 34,829 \times 0.2 = N6,965.80$

J. Billing Rate/Daily Billing Rate = Overhead + Labour + Profit (E + G + I) =
 $11,145 + 23,684 + 6,965.80 = N41,794.80$

The advantages of charging daily/hourly rates could include but not limited to the client will find it easy to understand how the fee was arrived at; it will be easier to develop a daily work plan; it will be easier to monitor and evaluate work done and therefore identify gaps; it will be easier to identify which elements contribute to high overhead costs and therefore enable the consultant take informed decisions on how to reduce costs. For example, if the rent is too high, the consultant may decide to work from home; the consultant will be more confident in defending the fee charged; fees are charged based on actual costs rather than emotional or other reasons, etc. While the disadvantages are having the paper qualifications (certificates) that matches his experience; the client may not be able to afford the rate charged; the consultant may find it too cumbersome to calculate; the consultant may not be able to work within the 'going' rate in the market; the consultant may not be good at factoring in the 'hidden' costs; the rate may not be applicable for all types of consultancies, etc. Charging hourly rates was well articulated by Dickson (2017) in his article "How much should a consultant cost" noting that you can convert an annual salary to an hourly rate by dividing it by 2080 (52 weeks x 5 days x 8 hours).

Lump Sum Charging

Charging a lump sum for a consultancy requires great skill and experience to charge accurately. Consultant's charges should not be arbitrary but must be based on a careful calculation of a breakdown of the tasks involved, the time, money and efforts required to do the job. It is after these have been analyzed by the consultant that he can charge the client a lump sum. This method is similar to Juliet's (1989) second method: "Rambo Rate" or "What the market will bear". He noted that in this scenario, the consultant examines the environment and charges what the market costs are. He determines the minimum and the maximum rates for similar projects and situates his fee within the range. Although, this sounds quick, easy and wise, the consultant will find it difficult to defend his rate when a client puts it to rigorous scrutiny. However, the lump sum method is used mainly for small consultancy jobs such as conflict resolution between staff and management.

Charging a lump sum is advantageous in the sense that it allows for greater flexibility in carrying out the tasks, it provides opportunity for flexibility in negotiating the fee and hidden costs can more easily be absorbed. On the other hand, the disadvantages could be a higher probability of forgetting to cost some tasks and therefore, the tendency is to undercharge; the total cost may look enormous and may be difficult to convince the client; there is greater likelihood of disagreement between consultant and client on the details of the scope of work to be carried out after the job commences.

Charging Per Task

Another method of charging is to charge per task. This is usually preferred for bigger jobs such as the establishment of a university library. In this case, the client is given the flexibility to determine the tasks that he wants to pay for because he may already have some expertise in-house. For instance, the client may like the consultant to select books, furniture and equipment but may prefer to do the ordering, purchase and clearing of the goods through a central unit within the organization. A more detailed illustration of tasks to be charged for and how charging per task may be done is given below:

A sample consultancy proposal charging per task may look like this:

- Cover Letter
- Table of contents
- Preamble
- Method of Approach
- Duration of Project
- Reporting
- Outputs from Consultant

-
- Inputs from Client
 - Consultancy Fee
 - Conclusion
 - Appendix I: Detailed Work Plan
 - Appendix II: Consultants Fee
 - Appendix III: Profile of Consultants
1. **Cover Letter:** Write a cover letter that details the methodology which the consultant intends to use to achieve the aims and objectives of the library and gives a brief background on the consultancy firm.
 2. **Preamble:** Do a short (one paragraph) SWOT analysis of the LIS environment and the justification for a library/resource centre. You may include short statements on copyright issues, a conceptual framework and the overall requirements of the client.
 3. **Methodology:** Detailed step-by-step approach on how the consultant will go about the task. For instance: (a). We will translate the library's mission statement into a Collection Development Policy and provide a framework to ensure meaningful and consistent growth of the collection over the next five years. We will also recommend and compile a list of relevant resources in the appropriate media to meet the needs of staff and students. We will provide a list of approximately 800 titles from which the management may select. (b). Using a library software agreed with the school's management, we will catalogue, classify and input into a database 1000 volumes of books within six weeks ensuring compliance with international standards.
 4. **Duration:** Give a time frame for completion of the work. Also, specify how many days and which tasks you would need to carry out onsite and which tasks you will carry out off-site.
 5. **Reporting:** How many reports will be provided? It should include all progress reports, briefing for management staff and the final report.
 6. **Output:** What will be the main output of the consultancy? What should the client expect at the end of the job? For instance: a library that meets international standards; a well-written collection development policy; an operations manual, an end of consultancy report, etc.
 7. **Inputs from the client:** What do you need from the client to be able to work efficiently and effectively? For instance: work space equipped with computer, printer, internet access; work tools such as Dewey Decimal Classification Scheme; Library of Congress Schedules, etc.
 8. **Consultancy Fee:** State expressly what your fees would be.

9. **Conclusion:** Usually a positive expression that shows that the consultant is committed to doing an excellent job and has a keen interest in getting the job.
10. **Appendices:** The consultant may attach appendices such as a detailed work plan; consultancy fee and consultants biography. Examples are provided below.

Appendix I: Detailed work plan

Task	Specific activity/items	Time	Comments
Selection of Books & other Materials			
	1. Identify sources 2. Select resources 3. Compile a list of relevant titles, including electronic resources and submit list	4 wks	off site
Develop Systems for Ordering, Purchase and Delivery of goods			
	1. Identify agents to order 2. Determine what to order through agents (local & overseas), what to purchase directly 3. Design systems to monitor and evaluate orders 4. Design systems for complaints and claims	4days	off site/on site
Staff Recruitment			
	1. Design advertisement 2. Shortlist qualified applicants 3. Interview with constituted panel 4. Appoint 5. Write report	4 days	On site
Processing of			

Materials			
	1. Organization of knowledge using standard metadata 2. Selection and use of Library Management Software 3. Data entry 4. Development of OPAC	7 wks	On site Work tools such as classification schedules to be provided by Institution
Operations Manual & Policies			
	1. Operations manual to include – policies, systems and procedures - Design menu of services and operations - Rules and regulations of library - Design user education/information literacy programme - Collection Development Policy -Develop database of vendors - Monitoring and Evaluation -Impact Assessment measures	3.5wks	Off site drafts submitted for approval at agreed intervals
Space planning & Acquisition of Furniture, Equipment, etc			
	Furniture, equipment, stationery 1. Identify sources 2. Select Library security system, PCs, tables, chairs, shelves, etc 3. Submit recommendations 4. Design space 5. Organize space	8days	On site
Training			

	For Library staff 1. Seminar on library and information services in the 21 st century 2 Learning resources on the internet for staff and users 3. Use of Library Management Software 4. Use of Operations Manual	4 days	On site
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Appendix II: Consultancy Fee (excludes cost of purchase, transportation and logistics)

Item	Fee (\$1=N360)
Selection of books and other materials (about 5000)	\$1700
Developing systems for ordering, purchase and delivery of goods (excluding cost of goods, transportation and clearing)	\$450
Staff Recruitment (excluding cost of advertisement and logistics)	\$450
Processing and shelving of materials (providing metadata, choice and use of Library Management Software, inputting data, accessioning, spine labeling, development of OPAC, etc (5000 titles);	\$3000
Production of Operations Manual and policy documents, including menu of services, Internet services, budgeting, evaluation procedure, impact assessment measures, etc	\$1500
Space Planning & Selection of Furniture, Equipment, etc (excluding cost of purchase, transportation and clearing)	\$600
Training of 5 staff for 4 days (excluding cost of travel and logistics)	\$450
<i>Total</i>	<i>\$8,150</i>

Appendix III: Bio-data of consultant emphasizing the experience and skills that qualify the consultant for the job.

The advantages of consultancy proposal are that tasks to be carried out are spelt out clearly and all parties understand their responsibilities; misunderstanding between parties is reduced, hence less potential for conflict and the consultant can avoid taking on tasks where he has no expertise such as clearing of goods ordered from overseas or where the fluctuation in market prices is high. The disadvantages on the other hand include the fact that the consultant may not have full control of the quality of assignment because some tasks may be given out to other people. If, for instance, the

institution provides poor quality furniture, it may affect the overall aesthetics of the library; the consultant's job may be delayed in the process of waiting for other clients to deliver on time. If book labels are not delivered as agreed, it may be difficult for the consultant to complete processing the books at the agreed time, and moreover, the tasks outsourced to the consultant may be so small that it may not be worth the time and effort, and the impact of his work may not be appreciated.

Challenges and Key Issues Facing Independent Consultants

Independent consultants may face some challenges while carrying out their tasks. Full time consultants usually do not spend more than fifty percent of their time working. Therefore, they have to find ways of ensuring that they are able to take care of their needs when they are not working. The common challenges they face may include:

Conflict in job schedules: unfortunately, consultants often have to deal with the issue of having more than one job offer at the same time. This means that even though he may not be engaged all the time, he may lose some jobs if he is faced with the problem of making a choice between more than one job offer in the same period especially because some clients may not be willing to wait. In such situations, consultants may negotiate with the clients to re-schedule the activities to a more convenient time, usually requiring an extension in the period to complete the task.

Consultant's skills and experience may be limited for all aspects of task required: a consultant may get a 'big' job and find that he does not have all the requisite skills to handle the tasks alone. For instance, if a consultant is requested to set up a university library, he may not be an expert in cataloguing and classifying materials or in using the library management software or in writing reports. In such cases, he may have to call in other colleagues to assist which may mean that his profit margin is reduced; quality of work of done may not be as good as desired or he may not find other experts who are available to take on the task. However, it is better to get experts who have the requisite skills to execute the task successfully than for the consultant to attempt to take on tasks he is not skilled in. Close supervision to ensure tasks are carried out according to the terms of contract is essential if someone else is being hired.

Poor contract agreement: consultants sometimes face the challenge of working with poorly spelt out contracts. Clients may be unable to define the real problem clearly until the consultant starts working and discovers that there may be other complex and underlying issues that may not have been revealed or may not have been obvious before the work commenced. However, once a contract has been signed by both parties, the most honourable thing for a consultant to do is to stick to the terms of the contract even

if it means making little profit or experiencing delays in job completion. Ultimately, if a client is satisfied, the chances are that he will recommend the consultant to another client and with previous experiences; the consultant is unlikely to make the same mistakes. If, however, the tasks are completely different from the original agreement, the consultant has every right to draw the client's attention to this fact and request to re-negotiate the contract before the new/additional task is done. As much as possible, it is always better to get a clear definition of the tasks required before the contract is signed.

Poor communication with management: a common challenge that consultants face is poor communication by the management/client who may inadvertently not disclose the full situation of things to him or may not even be aware of the extent of the problem. In trying to communicate his findings to management, there may be misunderstandings which may lead to either slowing down the pace of the work or if not well handled, it may lead to a termination of the contract.

Capacity for implementation of output may not exist in staff: another challenge is the implementation of the recommendations of the consultant. The reasons why some clients are unable to implement a consultant's recommendations include: limited skills, lack of funds and lack of political will. Non-implementation of recommendations may give the erroneous impression that the consultant has performed below expectation, which is not good for the image of the consultant. It is the responsibility of the consultant to train the staff to be able to implement the output of the consultancy. In circumstances where the consultant feels that staff cannot be trained adequately, he must inform the management and include it in his end of consultancy report.

Limited acceptance by staff: a consultant may have to work with staff who are not receptive. This may be because the principal client may not have been able to convince the staff of the need for a consultant or staff may resent being told that they do not have the relevant skills or experience, or may even feel threatened about losing their jobs. It is the responsibility of the consultant to be apolitical (neither taking sides with Management nor staff), empathetic and at the same time firm, open and truthful with the staff.

Finance: some clients may not be prepared to pay a part of the fee upfront; they may require that some work (no matter how little) is done before making financial commitments. In such instances, the consultant has to source for money to start the work and this may not be easy. Also, some clients may end up not paying the full fee of the consultant after the job is finished. Although the consultant can take the client to the law court, it may not be worth the time, money and effort. Therefore, in order to reduce

the risk, a consultant should ensure that the client meets at least ALL his costs and some profit before the final payment at the end of the job. That way, the worst case scenario is that the consultant will make only a little profit.

Working Alone Versus Employment of Staff and Rent of Office Space Vs Working from Home: consultants usually have the need for additional staff to assist in carrying out some tasks. However, because it is not a full time job, it may be expensive for the consultant to employ full time staff because he has to pay their salaries even when he has no consultancy job. Also, the consultant may find it challenging to rent an office space and equip the office fully because there are no guarantees of knowing when the next job will come. Independent consultant may find it more cost effective to work from home.

Threats from other Competitors: In Nigeria, there is still the challenge that clients think that almost ‘anybody’ can set up a library. The result is that many non-qualified librarians are engaged as consultants to establish libraries. The greatest threat is probably from computer science professionals and other professionals in the book trade industry. They usually use the fact that they understand how the library and information profession sector works to great advantage. For instance, computer scientists who can implement library management software packages to develop a library OPAC may convince the client that he can set up a library. Librarians need to be more proactive and aggressive in searching for consultancy business.

Suggestions

To improve library and information consultancy services in Nigeria, the following suggestions are offered.

Register the consultancy firm: it is recommended to have legal recognition by registering the consultancy company with the Corporate Affairs Commission (CAC) of Nigeria. This gives potential clients a higher degree of confidence that they are dealing with recognized experts in the field. The consultant may also be able to charge a higher fee because of the legal recognition.

Keep a pool of experts that you can outsource jobs to: a consultant should always have a pool of experts that he can draw on when the need arises. This will be necessary when the consultant needs to outsource jobs. For instance, in establishing a library, the consultant may decide to outsource the cataloguing and classification of books or get data entry clerks to input data using the library management software to create a database. It is important that the consultant understands the limits of his skills and when

it is more cost-effective to outsource a task. However, when a task is outsourced, it is the responsibility of the consultant to ensure quality control. He cannot abdicate the responsibility of delivering a good quality job.

Understand the scope of the job: it is important that the consultant understands the scope of the work before embarking on the job. It is not a good track record for the consultant to abandon a job mid-way because he suddenly realizes that he does not have the requisite skills or the pay is not adequate. Before signing the contract, the consultant should do a preliminary visit to inspect the environment and have pre-contract meetings with the client to clear any gray areas.

Sign a formal contract: it is good practice to sign a formal contract for any consultancy job, no matter how small the value of the contract is. This may come in useful when contentions arise while the job is on-going. The contract reminds both parties what they committed to and where a legal battle arises, it could prove useful. The Award letter for the contract is also an invaluable document to use as evidence of experience when applying for another job.

Consultancy Fee: ensure that the fee charged covers the total cost (including hidden costs such as electric power bills, if you are working from home). It may be necessary to get help to do proper costing. The essence is to make a profit that will keep you in business; consultancy is not a Charity where you work free-of-charge for people. The reality is that if your client is confident that the consultant has the requisite skills, he is likely to pay whatever fee is charged to a reasonable extent in order to get a good job. Remember that as an independent consultant you may only work 50% of the year, therefore, your costing must take into consideration the periods that you will be out of work. If costing is not properly done, the consultant may soon find himself out of business.

Use excellent negotiation skills: It is important that a consultant develops very good communication, negotiation and networking skills. These may come in handy when there are conflicts in job schedules. A good consultant may be able to re-negotiate a different time schedule for clients. He could agree to start off doing some preliminary tasks such as book selection while working on the other job. In some cases, using the services of other experts may be necessary to cope with the amount of work.

Keep Overhead Costs Low: An independent consultant should try as much as possible to keep overhead costs low. Rather than rent office space, the consultant may work from home and on-site, in the office of the client. Being efficient and effective are two key

concepts the consultant must always have at the back of his mind. How can he use as little as possible to achieve the greatest impact? He may not employ staff except when he has big jobs, in which case, he hires temporary staff and builds their costs into the contract.

Update Skills Regularly: A consultant must regularly update his skills and be on top of his game if he is to do well. Many clients have an idea of how a library should function, which puts great pressure on the consultant. Therefore, a prospective successful consultant should spend time and money attending training programmes; understanding new terminologies and concepts in the sector. For instance, a consultant should use the term “metadata” in place of cataloguing! Being current and confident are essential elements that please a client.

Conclusion

In the 21st century, with the advent of the Internet and Net Natives, libraries are expected to do more with less money! Therefore, there is need to think ‘out-of-the-box’ to make the most of the limited resources available. One of such ways is to outsource tasks and use consultants’ services where necessary. Using independent consultants is a rapidly increasing trend for providing an independent point of view; substantial savings in time, money and other resources; and specialized expertise problem solving. In order to understand the environment better and use a more business-like approach in dealing with the emerging trend, it is essential to develop a directory of library and information science consultants in Nigeria. Since other professionals sustain their livelihoods through consultancies, charging appropriate fees for library and information consultancy services using efficient and effective costing models is pivotal to achieving sustainable and successful consultancy enterprises in the sector.

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Author's Biography



Victoria Okojie is a Lecturer in the Department of Library and Information Science, University of Abuja, Nigeria and Member, IFLA Governing Board and Chair, IFLA Division V. Victoria has been working in the Library and Information sector for over 30years, with experience in both teaching and practice. She has worked in the University of Ibadan library; The Birtish Council Library; LARIS Department, University of Ibadan; as an independent consultant and as Registrar, Librarians'Registration Council of Nigeria. She currently lectures at the University of Abuja. She holds a Doctor of Philosophy degree (PhD) from the Ahmadu Bello University, Zaria, Nigeria.

IMPACTS OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) ON THE USE OF UNIVERSITY OF ILORIN LIBRARY

Grace, Olabisi Babafemi

University of Ilorin Library
E-mail: babafemi.go@unilorin.edu.ng
Phone Number: 08165249928

Abstract

The study examines the effects of information and communication technology (ICT) in the university of Ilorin library, Ilorin Kwara state, Nigeria. A case study research method was adopted. The major instrument was questionnaire while interview and observation were used to complement it. The sampling technique adopted was simple random. The statistical analyses used in analyzing the data are percentages and frequency counts. The findings revealed the automation of the library has reached 70% while the information and communication technology (ICT) in use includes the internet, OPAC (Online Public Access Catalogues) and CD ROM facilities. Most of the library staff have undergone computer training. Post graduate students have been trained, and undergraduate students have access to some facilities such as; databases usage to source for information in the e-library. The effects of using ICT in the Library revealed that it gives quick access to information and allowed users to be aware of more information resources available in their various disciplines. The users were able to utilize the ICT in the Library to source for academic materials. The research was able to show that the use of ICT is above average in the University under study. The challenges associated with the use of ICT revealed by the study are; inadequate power supply, lack of funds and insufficient computers. The study recommended that there should be more funds for maintenance and repairs, more professionals with ICT skills should be recruited and more powerful and reliable standby generator should be installed.

Keywords: Information and Communication Technology, Library usage,
Automation, Library services

Introduction

It has been found that almost all the Nigeria university libraries intended to automate their operations. Some have attempted it and it emerged colorfully while some dropped the idea for one reason or the other. Majority are still trying to cope with the challenges it brings. National University Commission (NUC) was the first to initiate the development of computers in libraries in all federal universities, with World Bank credit facility agreement. According to Ogunleye (1997), NUC directed the University Librarian of all Federal Universities at a meeting in Kaduna in 1990 to get their operations computerized and it was further said that the libraries will be given a computer set each in 1991. Nineteen of the University Librarians attended the meeting and 3 World Bank officials were in attendance. It was agreed in the meeting that each library was to cater for its own automation project.

At the second meeting, the librarians gave reports on the efforts made thus far to automate their libraries. It was indicated that most of the librarians had no sufficient equipment for computerization or did not have computer at all. Almost all the university libraries lacked the necessary manpower for computerization. The NUC promised to offer one micro-computer to each university library. The promise was fulfilled in 1994 with an information navigator for libraries (TINLIB) software which was installed in each of the libraries.

In November 1994, BUSICON (Nig) Tithe supplier of TINLIB software in collaboration with the NUC, organized a week-long training for the representatives of the Nigerian University Libraries. The representatives were made up of 3 librarians and one system administrator from each university libraries. The training was held in Ogbomoso for South West, Port Harcourt for South East, Jos and Zaria for Northern Zone.

The purpose of the workshop was to acquaint the librarians with use of and capability of TINLAB with the experience acquired at the workshop, it was anticipated that libraries should be able to continue with the automation project on their own without NUC interface support. A lot of achievements have been recorded in most academic libraries. Such as in University of Ibadan, University of Lagos, Obafemi Awolowo University, Ile-Ife and Ahmadu Bello University, Zaria, have gone far in automation.

According to a report, although some of the academic libraries have not discarded the manual system. In the same vein, almost if not all of the private universities like BOWEN University, Iwo, Osun state, Covenant University Otta, Ogun state, Landmark University, Omu-aran Kwara state, Babcock University, Ijebu-remo, Ogun state have recorded a huge success due to the fact that we are in information age in which the information tools being used is the new technology. Otunla/Akanmu-Adeyemo (2010) have identified under-funding of the university libraries as a major problem in the acquisition and application of information and communication to their services unlike before when 10% of the total budget to the universities are given to library. Most university librarian cannot spend the library budget anyhow. Most of library books/journals are provided for from TETFUND library intervention, and because automation is capital intensive, it consumes a lot of money and maintenance cost is even higher than initial cost.

Nigeria Telecommunication Limited and Nigeria Power Holding Limited make the matter worse by rendering epileptic services and their bills are always high. This affects the operation of ICT. Sometimes, it may be delay of the Universities to pay for services rendered like internet service fees and others. However, academic libraries in Nigeria

especially University libraries have resorted to acquiring the automated system for speedy, time saving, efficient and effective services of their operations.

Objective of the study

The main objective of the study was to examine the effects of information and communication technology (ICT) in the university of Ilorin library, Ilorin Kwara state, Nigeria. The specific objectives of the study are to:

1. Determine the level of ICT utilization at the university of Ilorin library.
2. Examine the level of ICT integration into the services of the library.
3. Identify the challenges of using ICT at the university of Ilorin library.

Literature Review

Background of University of Ilorin

The University of Ilorin is located in the ancient city of Ilorin, about 500 kilometers from Abuja, the Federal Capital Territory, Ilorin the capital of Kwara State (The State of Harmony) is strategically located at the geographical and cultural confluence of the northern and southern parts of Nigeria. The University is one of the seven institutions of higher learning established by the Decree of the Federal Military Government of Nigeria in August 1975. From the initial three faculties, the university has grown to 15 faculties with 60 academic departments, undergraduate degree programmes run for 3 years to 6 years, depending on entry qualifications and discipline.

Background to the University Library

University of Ilorin library was established in 1975. The library started immediately the university started, having a storey building called library with essential sections necessary for a College Library such as the readers services, technical services and the Librarian's office. These were extended later as the population grew to...Library staff number also grew to 110, necessary for the workforce.

The library has its permanent building at the main campus which was occupied in 1990 with 90,000 titles of books and journals and other library materials for all the programmes being offered. The automation of the library started in 1990 in which the NUC directed all Federal Universities Librarians to get their operations computerized.

The University of Ilorin linked up with the computer center now called COMSIT to help in making their dream of automation come true. The computer center started with the

circulation unit (reader services division) of the library, after progressing for a while, the library decided to have a software installed which all other university libraries are also using that is the TINLIB software, later changed to Alice for Windows and currently using KOHA software.

The automation of the library has covered all other sections in the library such as cataloguing, Acquisitions, Reader services, reference, currently the library has the E-library for use by students/staff/researchers for their electronic version such as data bases EBSCO, JSTOR, AGORA, HINARI, Science Direct e-journals and e-books etc.

The library has trained its staff on the use and operation of computer to perform their routines which were formerly performed by manual procedures. Staffs were sent to workshops, conferences and seminars to enhance their performances. The library is still on computerizing their services and in the future time, the library will computerize fully all their activities and services.

The OPAC has about 26 computers, each of the professional librarians has one, and we have about 150 laptops in the E-library for students/staff use. The library presently is small compare with the student's population of about 40,000, it can only take 1,5000 students at a time. The university is planning to start another library building soon to solve the problem of accommodation of library users.

The vision/mission of the library is in line with that of the university.

Vision: A library that ranks as one of the best globally in resource provision and service delivery to local, national and international community.

Mission: To provide efficient framework for attaining best practices in collection development, infrastructure, resources management and service delivery to library users for teaching, learning and community service.

ICT at the University of Ilorin

The current software package for use in the library is KOHA Library integrated software. This is being used in all sections, although presently there are still some of the sections that have not fully utilized the package. The library Internet access uses fiber optic cables. This makes the services functional and accessible. Students with their tablets use it often to do assignments, read online books and download. Students are allowed to use their personal computers in the E-library to search for information sources using passwords.

The library has electronic databases and online journals; EBSCO, JSTOR, AGORA, HINARI, OARE, Science Direct and NUC Virtual Library. These databases permit access to about 35000 electronic journals across all disciplines. This enhances access to resource-based materials for teaching, learning and research in the university. The library has 167 computers and 150 laptops to access electronics resources in the E-library section of the library, including 26 computers for OPAC situated at the main library. The E-library is fully air-conditioned, with high speed internet connectivity, printers, projector, and webcam facilities. This gives access for students and staff to do their research using electronic books/journals, access web-based literature searches for their projects/thesis, seminar presentation and other related assignments. There is internet access in the library using fiber optic cables. The service is 24 hours daily including Saturdays and Sundays except public holidays.

The library has installed a software package “KOHA”. This is being used in all of the sections though not fully, for instance at the circulation desk, materials on loans are charged manually, though registration of users are inputted into the system, the reference services is not totally on-line, also the document and serials section are on the take-off of the automation.

Advantages of Information and Communication Technology (ICT) in Libraries

Libraries are using ICT to automate technical services, to provide efficient reference and information services and operation such as cataloguing, acquisitions and circulation etc. If utilized properly ICT will help in the growth and development of libraries in different directions.

Some of the advantages of ICT to libraries according to Cochrane 1992 are as follows; allows easy integration of various activities, facilitates cooperation and the formation of library networks, help to avoid duplication of efforts within a library and between libraries in a network, eliminates some uninteresting and repetitive work, helps to increase the range of service offered, provides marketing opportunity for the services offered, increases efficiency, it also gives better access to information, it encourages improved productivity, it encourages possibilities for cooperation, it encourages resource sharing, it improves the status of the information professionals and it allows access to international databases.

Kargbo (2009) opined that the quality of an academic institution is measured by the resources for learning on the campus and the extent to which students become independent, self-directed learners. Therefore, it is not surprising that the NUC encouraged all universities to have well-equipped libraries with automation facilities to enable learning to be easy for transformation of the society, such facilities include

computer and telecommunication systems, databases and a host of other technologies (e.g. Radio, Television, mobile phones).

Kargbo further proposed an academic library automation which should include the following;

1. Application of computer technology of routine activities such as acquisitions, cataloguing, accessing security control and inter-library loans.
2. Use of reference database on CDROM housed in these libraries
3. Access to remote databases such as library catalogues and circulation databases through technological lines and internet
4. Office automation and networking

MacCroll (2001) mentioned that automation will lead to better inventory control methods and management of library routine or services. Otunla and Akanmu-Adeyemo (2010) tries to draw out the challenges library automation in Nigeria, which could be a general one as erratic power supply, inadequate professional libraries to handle the project, absence of maintenance and support agreement, poor ICT infrastructure, poor funding, poor ICT skills among staff.

In the same paper Otunla/Akanmu-Adeyemo (2010) saw the issue of software for library automation as one of the major issues in Nigeria. Many academic libraries are changing from software to another; this change of software has affected the progress and success of automation program in Nigerian libraries. Presently, the University of Ilorin is using KOHA software for its operation and services in some of the section such as technical services (excluding acquisitions and serials), reader's services excluding reference and documents and e-library support services.

In University of Ilorin Library, the bibliographical details of library materials are being uploaded, the library also offers programme to students to be able to effectively use information and communication technology equipment, starting with post-graduate students, and now working on undergraduates. The library has the challenge of subscription to databases but its being addressed.

Methodology

A case study research method was adopted. The major instrument used for this work was questionnaire, which was supported with oral interview and on the spot observation. The questionnaire was administered to students of University of Ilorin (users). The users were allowed to tick their responses and were later collected by the researcher. The questionnaire was designed to collect information on;

1. Level of information and communication technology in the university of Ilorin library.
2. The integration of ICT with the services of the library
3. The challenges associated with the use of ICT in the use of ICT in the library

Structured Interview

An oral interview was conducted with the head of Electronic Support Services; the result was meant to supplement the information supplied by the respondents of the questionnaire. The result shows that the library is making effort in its automation project.

Personal Observations

The researchers examined the activities in the automated sections of the library (technical services division, cataloguing unit) and reader's services division (circulation unit) e.g types of computers in use/software in use).

Data Analysis and Discussion of Findings

The format of the research instruments which contained various sections was used as a guideline for analyzing the data. In explaining the data, a descriptive approach was employed by which themes and patterns that emerged from the data were used to address the research questions. In analyzing the data, Statistical Package for Social Science (SPSS) was used. The data is presented using simple percentage rounded to one decimal place for easy comprehension. The return rate of the questionnaire is 95%. This is because 95 copies of questionnaire were retrieved back out of the 100 copies administered. This is represented in the table 1.

Table 1: Return Rate

Copies Administered	Copies Returned	Percentage Return/Valid
100	95	95%

Table 2: Distribution of respondent by Faculty

	FACULTY	FREQ	PERCENT (%)	CUMULATIVE. PERCENT (%)
1.	Agriculture	9	9.5	9.5
2.	Arts	8	8.4	17.9
3.	Basic Medical Science (BMS)	4	4.2	22.1
4.	Communication & Information Science	8	8.4	30.5
5.	Life Science	7	7.4	37.9
6.	Law	6	6.3	44.2
7.	Physical Science	2	2.1	46.3
8.	Clinical Science	4	4.2	50.5
9.	Management Science	12	12.6	63.2
10.	Social Science	3	3.2	66.3
11.	Education	11	11.6	77.9
12.	Environmental	4	4.2	82.1
13.	Engineering and Technology	12	12.6	94.7
14.	Pharmacy	3	3.2	97.9
15.	Veterinary Medicine	2	2.1	100.0
Total		95	100.0	

In Table 2, respondents vary with faculties. However, all the fifteen Faculties in the University are represented. Faculty of Agriculture has frequency counts of 9 (9.5%), Arts 8 (8.4%); BMS 4 (4.2%); Communication and Information Science 8 (8.4%); Life Science 7(7.4%); Law 6(6.3%); Physical Science 2(2.1%); Clinical Science 4(4.2%); management science 12(12.6%); Social Science 3 (3.2%); Education 11 (11.6); Environmental 4 (4.2%); Engineering and Technology 12 (12.6%); Pharmacy 3 (3.2%) and Veterinary medicine has frequency of 2 (2.1%).

Table 3: Distribution of Respondents by Academic Level

	Frequency	Percent	Cumulative Percent
100	13	13.7	13.7
200	21	22.1	35.8
300	31	32.6	68.4
400	24	25.3	93.7
500	6	6.3	100.0
Total	95	100.0	

The respondents' Academic Level ranges from 100Level to 500Level. Those in 100L has frequency of 13% (13.7%); 200Level has 21 (21.1%); 300Level 31(32.6%); 400Level 24(25.3%); 500Level 6(6.3%).The result shows that 300 Level students benefited from the use of ICT in the Library than the other levels. The sample size which is 100 was based on the evening period of 6:00pm to 8:00pm, when students might have finished the days' lectures, at this times students are few in the Library. Majority of the students will go to the hostel while few will come to the library to do assignment or prepare for test. The total number of registered users in the Library is 161,233 since inception.

Table 4: Level of ICT Application on Library Services

	Fully Applied	Partially Applied	Not Applied	ROW TOTAL
LIBRARY SERVICES	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Registration of Users	72(75.8%)	13 (13.7%)	10 (10.5%)	95 (100%)
Information services (Ref)	48(50.5%)	37 (38.9%)	10 (10.5%)	95 (100%)
Cataloguing	65(68.5%)	18 (18.9%)	12 (12.6%)	95 (100%)
Classification	64(67.4%)	27 (28.4%)	4 (4.2%)	95 (100%)
Indexes	58(60%)	26 (27.4%)	12 (12.6%)	95 (100%)
Abstracts	58(60%)	28 (29.5%)	10 (10.5%)	95 (100%)
OPAC	59(62.1%)	21 (22.1%)	15 (15.8%)	95 (100%)
Lending Services	49(51.6%)	29 (30.5%)	17 (17.9%)	95 (100%)

Serial Control Services	62(65.2%)	21 (22.1%)	12 (12.6%)	95 (100%)
Resource Sharing Networks	55(57.9%)	22 (23.2%)	18 (18.9%)	95 (100%)
Administration Duties	69(72.6%)	17 (17.9%)	9 (9.5%)	95 (100%)
Internet Services	61(64.2%)	25 (26.3%)	9 (9.5%)	95 (100%)
Online Databases	41(43.1%)	33 (34.7%)	21 (22.1%)	95 (100%)
Intercom Facilities	25(26.3%)	40 (42.1%)	30 (31.6%)	95 (100%)
Films and slides	30(31.6%)	41 (43.2%)	24 (25.3%)	95 (100%)
Library Security System	53(55.8%)	31 (32.6%)	11 (11.6%)	95 (100%)
COLUMN TOTAL	869	429	224	1522

This table shows that the application is more in administrative duties, followed by in

Table 5: Frequency of Utilization of ICT Resources

Level of Utilization of ICT Resources	Highly Utilized	Utilized	Not Utilized	Total
Registration of Users	63(66.3%)	17(17.9%)	15(15.8%)	95(100.0%)
Information Services (Ref)	54(56.9%)	28(29.5%)	13(13.7%)	95(100.0%)
Cataloguing	59(62.1%)	24(25.3%)	12(12.6%)	95(100.0%)
Classification	50(52.6%)	33(34.7%)	12(12.6%)	95(100.0%)
Indexes	53(55.8%)	28(29.5%)	14(14.7%)	95(100.0%)
Abstracts	47(49.4%)	32(33.7%)	16(16.8%)	95(100.0%)
OPAC	37(39%)	33(34.7%)	25(26.3%)	95(100.0%)
Lending Services	47(49.5%)	22(23.2%)	26(27.4%)	95(100.0%)
Serial Service Control	44(46.4%)	32(33.7%)	19(20.0%)	95(100.0%)
Resource Sharing	45(47.3%)	27(28.4%)	23(24.2%)	95(100.0%)
Networks	47(49.5%)	32(33.7%)	16(16.8%)	95(100.0%)
Administration Duties	55(57.9%)	23(24.2%)	17(17.9%)	95(100.0%)
Internet Services	40(42.1%)	29(30.5%)	26(27.4%)	95(100.0%)
Online Databases	24(25.3%)	39(41.1%)	32(33.7%)	95(100.0%)
Intercom Facilities	20(21%)	39(41.1%)	36(37.9%)	95(100.0%)
CDRom Facilities	20(21%)	39(41.1%)	36(37.9%)	95(100.0%)
Films and Slides	43(45.3%)	32(33.7%)	20(21.1%)	95(100.0%)
Library Security (3m Library System)	748	509	358	1615
COLUMN TOTAL				

cataloguing and classification than any other. The level of ICT application in cataloguing unit is fully applied (68.5%). Most of the cataloguing data are imputed into OPAC for easy access by users using Resources Description and Access (RDA). While, application of ICT in classification unit is partially applied 67.4%, this is because the unit uses online Library of Congress to classify the library books, thus save the time of the classifier and allow them to work on many titles for each day.

This table shows that ICT resources are used more in circulation for registration of users (66.3%) followed by cataloguing section (62.1%) than any other. This allow the users to register without stress and save the library from registering non-student and non-staff members, by using matriculation numbers and staff file numbers respectively. This allows the library to know the statistics of users per year. On the other hand, cataloguing tools needed for ICT are made available and subscriptions were paid yearly by the university through the library.

Table 6: Level of Utilization of ICT Resources				
Level of Utilization of ICT Resources	Highly Utilized	Utilized	Not Utilized	Total
Registration of Users	36(37.9%)	22(23.2%)	37(38.9%)	95 (100.0%)
Information Services (Ref)	45(47.4%)	32(33.7%)	18(18.9%)	95 (100.0%)
Cataloguing	45(47.4%)	30(31.6%)	20(21.1%)	95 (100.0%)
Classification	43(45.3%)	38(40.0%)	14(14.7%)	95 (100.0%)
Indexes	49(51.5%)	30(31.6%)	16(16.8%)	95 (100.0%)
Abstracts	54(56.5%)	25(26.3%)	16(16.8%)	95 (100.0%)
OPAC	54(56.9%)	21(22.1%)	20(21.1%)	95 (100.0%)
Lending Services	59(62.1%)	20(21.1%)	16(16.8%)	95 (100.0%)
Serial Service Control	51(53.7%)	28(29.5%)	16(16.8%)	95 (100.0%)
Resource Sharing Networks	57(60%)	22(23.2%)	16(16.8%)	95 (100.0%)
Administration Duties	43(45.2%)	28(29.5%)	24(25.3%)	95 (100.0%)
Internet Services	39(41.1%)	25(26.3%)	31(32.6%)	95 (100.0%)
Online Databases	53(55.8%)	24(25.3%)	18(18.9%)	95 (100.0%)
Intercom Facilities	64(47.4%)	25(26.3%)	6(6.3%)	95 (100.0%)
CD-Rom Facilities	71(74.8%)	13(13.7%)	11(11.6%)	95 (100.0%)
Films and Slides	63(66.3%)	26(27.4%)	6(6.3%)	95 (100.0%)
Library Security (3m Library System)	54(56.9%)	17(17.9%)	24(25.3%)	95 (100.0%)
COLUMN TOTAL	880	426	309	1615

This table shows that the users utilized CD-ROMs available in E-lib than any others with (74.8%)CD-ROMs are devices that are used to store and retrieve information. Most books came with CD-ROMs which when received will be sent to e-library for users. Though, library subscribe to online databases but the level of utilization is low (55%). Databases are used to access information and download e-resources (books and journal), mostly during accreditation.

Table 7: Interview Questions and Answers

S/N	Question	Answer	remarks
1.	What is the present stage of automation and level of ICT in University of Ilorin?	Bibliographic details of library materials are currently being uploaded	At the developing stage
2.	What is the total number of automated section in University of Ilorin Library?	Two (2). Namely: Readers Services, and Technical Services (excluding Acquisitions)	Library not fully Automated
3.	What Software package is the University Library using at present?	KOHA	Open Software
4.	Does the Library offer any programs to students regarding the effective use of Information and Communication Technology equipment?	Yes, The library started with postgraduate students and it is now working on a documentary on the use of the library for undergraduate. This is because of the large numbers involved	The library is yet to offer Programs to Undergraduate students
5	What are the challenges faced by the University of Ilorin Library	The challenge use to be subscription to databases but the challenge has been addressed. But now, the major challenge is power outage.	Power outage is the major challenge

This table shows that application and utilization of ICT in University of Ilorin library is on-going and the issue of power outage is being address by the university authority.

Interview Report

It was gathered that the library is not fully automated because there are some units (e.g. acquisition) that are yet to be automated. Consequently, the library is just at the conversion stage for bibliographic details of its records. However, the library software used in the library is KOHA.

Discussion of Findings

The application of ICT in University of Ilorin library is not fully but partial. It is discovered that cataloguing and circulation units make use of ICT than any other units. The issue of power outage is one of the problems facing the library. The library has not

extend their services to the postgraduates are their priority. The use of ICT has greatly reduced stress, save time of staff and users, and allowed for efficient and effective work among staff in the library.

However, there is still need for more support from the administration and library management in form of finance and manpower, as it is opined by Otunla and Akanmu Adeyemo, that for a successful library automation project including ICT “there is need for adequate finance, constant power supply, infrastructure, an experienced consultant and dedicated members of staff and proper training of library staff”

However, this could affect the quality of service rendered in the university Library. Meanwhile, these ICTs are yardstick for determining a standard library and are also necessary for learners. This is a confirmation to the statement of Kargbo (2009) who opined that the quality of an academic institution is measured by the resources for learning on the campus and the extent to which students become independent, self-directed learning.

The frequency of Utilization of ICT resources in University of Ilorin Library

Library users in University of Ilorin Library make use of the available ICT facilities on an average level. This is because the highest response of the average respondents is that they “Utilized” the resources frequently. Meanwhile, they make use the ICT facilities for their library registration and they least utilize audiovisual materials in the library (from Table 5). Therefore, there frequency of utilization is at the “average level”.

The Levels of Utilization of ICT Resources in University of Ilorin Library

In University of Ilorin Library, it was gathered that average library users “Highly utilize” utilize the library resources (From Table 6). The ICTs available in the University Library are being utilized by the library users. This is tantamount to say that the users are vast in the ICT usage and this may have a positive ripple effect on their academic performance.

The Challenges faced by the Library in automating the library fully

As stated in Table 7 above, the library is majorly faced with the problem of epileptic power supply apart from the subscription problem earlier faced. Apart from this, does not have all the needed ICT appliances required for a standard academic library.

Conclusion

The Unilorin library automation, ICT application and utilization is still on-going. Since it was not fund that is the problem, it is likely that they will eventually succeed in their attempt.

Recommendations

This study is recommending the following in order for the application and utilization of ICT to succeed in Unilorin library. There is need for a standby generator; this will be owned by the library to service its functions. Subscription to databases must be constant and be renewed as at when due. Users should be encouraged to make use of ICT by publicizing the ICT resources among users through orientation programme that will address ICT usage alone and not the general library orientation. Staff should also be properly trained and re-trained Lastly, library should not be changing their software so as not to disrupt ICT usage and application, just as Otunla and Akanmu-Adeyemo (2010) mentioned in their submission that the problem of library automation in Nigeria are; erratic power supply, inadequate of professionals to handle the project, absence of maintenance and support agreement, poor ICT infrastructure, poor funding, poor ICT skills among staff and software problem. If all the above is taken care of, ICT application and utilization will be better in Unilorin library and other academic libraries that are facing the same difficulties.

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A MODIFICATION OF UTAUT MODEL TO DETERMINE ACADEMICS' ADOPTION AND USE OF OPEN ACCESS PUBLISHING

M.T. Bashorun

Department of Library and Information Science
University of Ilorin, Nigeria
Bashorun.m.t@unilorin.edu.ng

Abstract

Open Access (OA) publishing system aims to provide free access and wide dissemination of information. Although universities in Nigeria have started to embrace OA initiatives recently, its adoptions and uses remain slow. Therefore, this paper explores factors of academics' adoption and use through a research survey approach by gathering empirical evidence based on the adapted Unified Theory of Acceptance and the Use of Technology (UTAUT). Survey Data collected from 337 respondents was examined using Statistical Package for Social Sciences (IBM-SPSS) version 19.0. The results show that awareness, attitude, performance expectancy, effort expectancy, and Internet self-efficacy significantly influenced the adoption and use of OA publishing by academics in selected universities in Southwest, Nigeria. Moreover, as a result of this study a modified UTAUT model was proposed. Such a model contributes to the discussion and development of adoption model for OA publishing in Nigeria context. The significance of the study is in three-fold: theoretical, societal, and practical. The significance of the findings, recommendations and future research directions are discussed.

Keywords: Adoption and use, Open access publishing, Universities, UTAUT, Nigeria

Introduction

Open Access (OA) publishing has become an important strategic approach to scholarly publishing system in many countries around the world. Many of these countries have proceeded to embrace and use OA publishing. It reflects the intention for tertiary institutions especially universities to take advantage of the communications improvements made possible by the Information and Communication Technology (ICT) and Internet revolution. OA publishing has enormous benefits: it improves free access and wide dissemination of scholarly content without restriction except cost of Internet service. OA publishing has potential to bridge gap between developed and developing countries. In spite of the huge benefits of OA publishing its adoption and use in Nigeria is slow (Gbaje, 2010; Oluwasemilore, 2013). According to Chan, Krisop and Arunachalam (2011) despite the improved access to the Internet, academics and researchers in the developing world continue to face two types of problems: difficulty in gaining access to academic publications and getting research published in international

journals has been a problem. However, the adoption and use of OA publishing is quite different from traditionally publishing approach, it requires a deep understanding of academic needs and requirements and comprehensive manner for successful application of the Internet.

OA publishing has started evolving in Nigeria with the aids of Internet that serves as a platform for OA initiatives. ICTS and Internet has made an essential transformation in Nigeria society, attitude and the ways of conducting, accessing, and disseminating scholarly work by utilizing the potential of ICT and Internet as a tool in the current scholarly activities. Therefore, the emergence of OA publishing has been identified as one of the modes of scholarly communication system that promotes effective, efficient access and wide dissemination of research findings for scholarly communities. What is supreme to academics is access and wide dissemination of their scholarship works from which they seek no direct financial benefit (Bashorun, 2016). Hence, this paper identifies the factors that influence academics 'adoption and use of OA publishing by applying an adapted UTAUT Model. According to Venkatesh, Morris, Davis and Davis(2003) UTAUT is an empirically validated model combining eight major models of technology acceptance and their extensions. This makes UTAUT model to have the highest explanatory power (69%).

Although, empirical studies that had established factors influencing adoption and use of OA publishing by academic staff in Nigerian universities are many, none of these studies seem to use UTAUT model as a lens to examine the identified factors. Thus, there is a need to explore the vital factors of academics' adoption and use of OA publishing in Nigeria context through a research survey approach by gathering empirical evidence based on modified UTAUT model with intention of closing the gap in literature. Therefore, this study examines factors that influence the adoption and use of OA publishing with main aim of validating or invalidating the major proposition.

Literature Review

Open Access Concept

Open access (OA) is a new concept in the scholarly communications system. Many scholars, researchers and other stakeholders around the world follow this phenomenon hoping to reduce costs, improve access to information and to provide wider, effectiveness, and efficiency dissemination of information to users without geographical barriers. OA is an essential initiative that comes to existence in order to promote free access and wide dissemination of research findings. The main principle behind OA is to maximize access to research. According to Frandsen (2009) scholars from developing countries have limited access to research publications due to

expensive subscription costs. The exorbitant prices of journals as well as the enabling Information and Communication technologies (ICTs) have prompted academics, researchers, scholars and other stakeholders to devise an alternative mode of scholarly publishing. This alternative mode, referred to as OA publishing, aims at achieving free access and a wider dissemination of scholarly work without barrier to users (Moller, 2006; Jain, 2012; Suber, 2012).

OA literature is digital, online, free to access and free from most copyright and licensing constraints (Suber, 2012). OA publishing has dramatically transformed the research landscape in universities worldwide in the twenty-first century. The most influential definition of open access is the one by the Budapest Open Access Initiative in (BOAI), OA is defined as: free availability on public Internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the Internet itself (2002, p.1). Hence, OA publishing can be defined as a new mode of scholarly communication, that is digital, online whose contents can be accessed free of charge at the point of consumption by the users via the Internet. There are two main basic strategies that can be used to achieve the main objective of open access initiative. These two approaches are Open Access journal (Gold route)/OA publishing and Open Access archive (Green route). For the sake of time and financial implication, this study mainly focused on OA publishing.

The Unified Theory of Acceptance and Use of Technology (UTAUT)

Information technology acceptance and adoption research has developed several competing and harmonizing models/theories each with a various set of adoption determinants. Many models and theories exist to attempt prediction of human behaviour focusing the intention to adopt technology or its use as the key dependent variable(s). These models have developed over the years and came as a result of determined efforts towards models' validation and extension that took place at different times and each was presented to the scholarly community. These theories, however, lack a unified view towards understanding the domain. The recent proposed work by Venkatesh et al. (2003) was advanced from the portioned view of technology acceptance to a unified view. The integration of the model was done by synthesizing from eight existing models of use of technology. The technology acceptance models include: Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980); Technology Acceptance Model (TAM) (Davis, 1989); Theory of Planned Behaviour, (TPB) (Ajzen, 1985); Motivational Model (MM) (Davis, Bagozzi & Warshaw, 1992); The Combined TAM and TPB (C-TAM-TPB) (Taylor & Todd, 1995); Model of PC Utilisation (MPCU) (Thompson, Higgins & Howell,

1991); Social Cognitive Theory (SCT) (Bandura, 1986) and Innovation Diffusion Theory (IDT) (Rogers, 1995). The 32 variables found in the existing eight models were compressed into four key variables and four moderating factors. The combinations of the independent and moderating variables have resulted to an increased in the predictive efficiency to 70%, a huge improvement over TAM model rates of 30% and TAM2 (TAM extension) with 40% predictive efficiency. The UTAUT model identifies the key factors in acceptance of ICT as measured by behavioural intention to use the technology and actual usage. The UTAUT has four variables (i.e. performance expectancy, effort expectancy, social influence, and facilitating conditions) that influence behavioural intention to adopt and use a technology. The most prominent amongst these models are TRA, TAM, TPB, TAM2, IDT) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003).

UTAUT is one of the latest developments in the field of general technology acceptance models. Like earlier acceptance and adoption models, it aims to explain user intentions to use an Information System (IS) and further the usage behavior. Venkatesh et al. (2003) created this synthesized model (UTAUT) to present a more complete picture of the acceptance process than any previous individual models had been able to do. Eight models previously used in the IS literature were merged in an integrated model, all of which had their origins in psychology, sociology and communications.

Each model attempts to predict and explain user behaviour using a variety of independent variables. A unified model was created based on the conceptual and empirical similarities across these eight models. The UTAUT holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are predictors of usage intention and behavior (Venkatesh et al., 2003). Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs on usage intention and behavior as indicated in Figure 1. The predictors are defined as follows:

1. Performance expectancy (PE): “is the degree to which an individual believes that using the system will help him or her to attain gains in job performance.”
2. Effort expectancy (EE): “is the degree of ease associated with use of the system.”
3. Social influence (SI): “is the degree to which an individual perceives that important others believe he or she should use the new system.”
4. Facilitating conditions (FC): “is the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.”

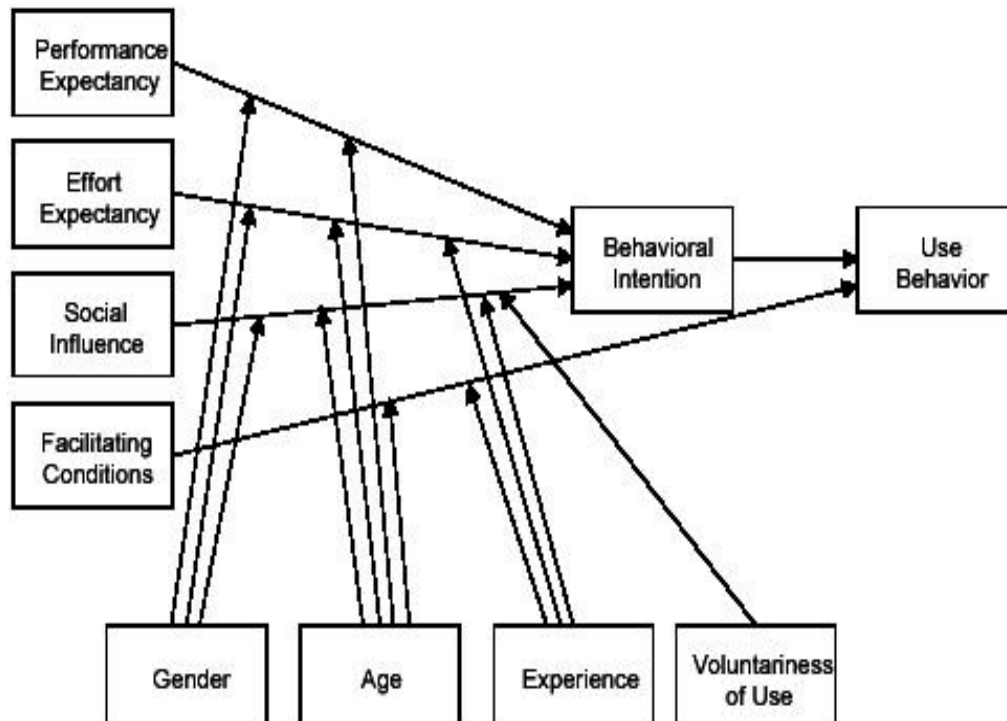


Figure. 1. The Unified Theory of Acceptance and Use of Technology (UTAUT)
Source: (Venkatesh et al., 2003:447)

Research Model and Hypotheses Development

Based on the attributes of innovations posited by Venkatesh et al.(2003) on UTAUT and its modification, this study proposes the following main hypothesis to predict the influence of the adoption and use of OA publishing by academic staff in universities in Nigeria. The researcher hypothesized the relationships between the variables as shown in Figure2.

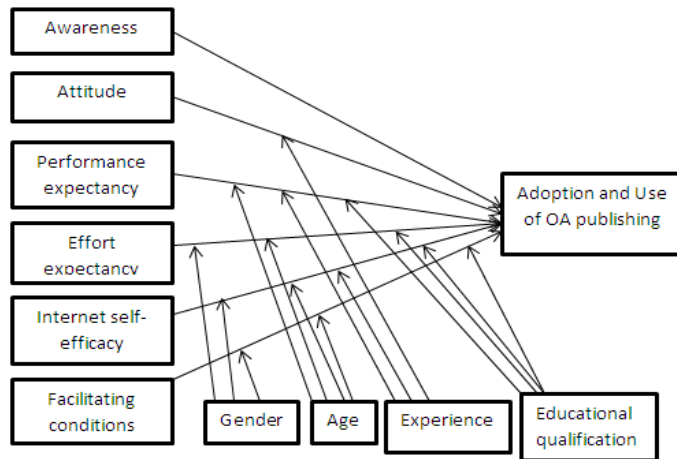


Figure.2. Research Model

Awareness

Awareness plays a vital role. Adequate knowledge about a concept leads to awareness. Dinev and Hu (2005, p.41) define awareness as “raising consciousness and knowledge about a certain technology and its personal and social benefits”. Awareness of OA publishing can be defined as raising perception and sufficient knowledge about OA publishing with its associated benefits. Awareness of an innovation is an important factor in the innovation-decision or adoption process. According to Rogers (2003, p.171) such awareness takes place when “an individual is exposed to an innovation’s existence and gains an understanding of how it functions”. Dinev and Hu (2005) establish awareness as the central determinant of user attitude and behaviour towards technology. Several studies (Warlick & Voughan, 2007; Fullard, 2007; Emojorho, Ivwighregwta & Onoriode, 2012) acknowledge that awareness is one of the essential factors determining usage in OA circumstances. This is supported by Dulle (2010) who says that awareness determines usage of scholarly communication. Based on the importance of awareness in determining the relationship with adoption and use of OA publishing, the hypothesis is proposed in Table 1(H1) and other hypotheses discussed as follows:

Attitude

Attitude is an individual’s overall affective reaction to using a system (Venkatesh et al., 2003). The UTAUT model’s assumption that the effect of attitude is captured by the existence of other constructs, such as efforts expectancy and the model, does not

consider attitude construct as having a major influence on the behavioural intention of technology usage (Venkatesh et al., 2003). However, several studies (Chau & Hu, 2002; Louho, Kallioja & Oittinen, 2006) established that individuals' attitude towards technology had a strong effect on the adoption and use intention. Chau and Hu (2002) point out that the attitudes towards computers are important for technology acceptance decisions as well as behavioural intent to physicians and nurses. In addition, Louho et al. (2006) argue that attitude has a strong effect toward technology behavioural intention to use.

Kim, Chun, and Song, (2009) indicate that the moderating effect of the strength of attitude on behaviour may result in a strong behavioural intention to use the system. The positive relation between attitude and behavioural intention is likely to be more pronounced when the attitude is stronger than when it is weak (Kim et al., 2009). The authors investigated the perspective in order to understand technology adoption characterizations and the role of attitude-strength. The results of the study showed that attitude was a major factor in determining the behavioural intention to technology use. Also, their findings showed the need for a redirection of technology adoption research to factors affecting attitude-strength. Studies (Dulle, Minishi-Majanja & Cloete, 2010; Mammo & Ngulube, 2013; Obuh, 2013) examined attitude towards OA publications and their findings indicated that researchers developed positive attitude towards OA. The study is important to avoid situations where technology is accepted but not put to actual use. The measure used in the study remains one of many factors explaining attitude-strength in the context of technology adoption and use. Therefore, the hypothesis is proposed in Table 1 (H2):

Performance expectancy

The performance expectancy variable indicates that the end users would show positive acceptance towards information system if it improves productivity or accomplished the task. Dulle (2010) carried out a survey among academics in Tanzanian public universities using the UTUAT as a research theory. The study proposed that performance expectancy had a major impact in forecasting behavioural intention. Before an individual could use the system in place, one would consider the benefits. Many academic staff in Nigerian universities would like to consider the benefits of OA publishing before its use.

Several technology acceptance studies have acknowledged the strength of performance expectancy in predicting behavioural intention and usage of technology (Al-Qeisi, 2009; Garfield, 2005; Zhou, Lu & Wang, 2010). According to the UTAUT model, it is expected that individuals will build interest in using a certain technology, if they believe that it will enable them to improve their performance in whatever task they have at hand.

This means that unless the new technology improves efficiency or the quality of an individuals' job, it is less likely to attract their interest in it. Hence, the hypothesis is proposed in Table 1(H3)

Effort expectancy

Kijisanayotin, Pannarunothai and Speedie (2009) observe that effort expectancy is similar to the perceived ease of use construct in TAM and IDT models and complexity of technology construct in the MPCU model. Several scholars (Chang et al., 2007; Gupta, Dasgupta & Gupta, 2008) have established that effort expectancy has a vital influence on intention to use behaviour. Contrary to that, Chau and Hu (2002) observe that effort expectancy does not have significant influence over the intention to use behaviour. The model assumes that individuals are likely to display interest in technology usage if that technology is convenient to use. This implies that less complicated technology will attract adoption intention of more users than complex technologies. Dulle, (2010) points out that age, gender and experience play a vital moderating role for effort expectancy towards technology adoption behavioural intention. Effort expectancy is said to influence behavioural intention and is stronger for women, older workers and those with little experience than for other categories of people (Dulle, 2010). Thus, it is reasonable to assume that academics in universities in Nigeria would adopt and use OA publishing provided it is suitable and rigor free. Thus, the statement is proposed in Table 1 (H4):

Internet self-efficacy

Internet is one of the technologies widely used today to access and share information. The use of Internet requires certain skills for set target to be achieved. For OA publishing, Internet serves as a platform (Gbaje, 2010). According to Hsu, Chiu and Ju, (2004, p.768) Internet self-efficacy refers to "what individuals believe they can execute with the Internet skills they acquire". According to Dulle(2010), Internet self-efficacy is about what individuals believe regarding their capabilities. This might not be necessarily indicating whether they are actually be able to accomplished. Studies (Ifinedo, 2006; Hsuet al, 2004) have demonstrated that technology self-efficacy plays a vital role in the acceptance and use of technology. According to Dulle (2010), exploitation of OA is dependent on Internet usage, except that academics exhibit to have specific competences to use the Internet in disseminating and accessing research

findings, they may not gain from OA publishing. Individuals' decision towards adoption and use of OA publishing is influenced by Internet self-efficacy. Hence, the statement is hypothesized as shown in Table1 (H5):

Facilitating conditions

Facilitating conditions (FC) is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system” (Venkatesh et al., 2003, p.453). FC represents organizational and technical support which is typically significant in both voluntary and mandatory settings in the early stage of usage. FC is a variable of the UTAUT model and is made of factors such as availability of funds, availability of university policy, perceived behavioural control, organizational, infrastructure and electricity power supply. FC includes management support, training and provision of technological support and focuses on removal of barriers in technological usage (Venkateshet al., 2003). Scholars in the field of technology studies (Chang et al., 2007; Venkatesh et al., 2003) have found that the FC construct has a positive effect on innovation use. However, it does not predict intention to use IT when both constructs, performance expectancy and effort expectancy, are used in the same model. FCs includes management support, training and provision of technological support all of which focus on removal of barriers in technological usage (Venkatesh et al., 2003). It seems FC plays an essential role as regards to adoption and use of OA publishing. Hence, the statement is hypothesized as indicated in Table1 (H6).

Table1: Hypotheses of the Study

No	Hypotheses
H1	Awareness will have a positive influence on adoption and use OA publishing.
H2	H2; Attitude will have a positive influence on adoption and use of OA publishing. H2a: Experience will positively moderate the influence of attitude on adoption and use of OA publishing
H3	H3: Performance expectancy will have a positive influence on adoption and use OA publishing. H3a: Gender will positively moderate the influence of performance expectancy on adoption and use of OA publishing H3b: Age will positively moderate the influence of performance expectancy on adoption and use of OA publishing H3c: Educational qualification will positively moderate the influence of performance expectancy on adoption and use of OA publishing
H4	H4: Effort expectancy will have a positive influence on adoption and use OA publishing. H4a: Gender will positively moderate the influence of effort expectancy on adoption and use of OA publishing H4b: Age will positively moderate the influence of effort expectancy on adoption and use of OA

	publishing H4c: Experience will positively moderate the influence of effort expectancy on adoption and use of OA publishing H4d: Educational qualification will positively moderate the influence of effort expectancy on adoption and use of OA publishing
H5	H5: Internet self-efficacy will have a positive influence on adoption and use OA publishing. H5a: Gender will positively moderate the influence of Internet self-efficacy on adoption and use of OA publishing H5b: Age will positively moderate the influence of Internet self-efficacy on adoption and use of OA publishing H5c: Experience will positively moderate the influence of Internet self-efficacy on adoption and use of OA publishing H5d: Educational qualification will positively moderate the influence of Internet self-efficacy on adoption and use of OA publishing
H6	H6: Facilitating conditions will have a positive influence on adoption and use OA publishing. H6a: Age will positively moderate the influence of facilitating conditions on adoption and use of OA publishing H6b: Educational qualification will positively moderate the influence of facilitating conditions on adoption and use of OA publishing

Methodology

The present study used quantitative research method and questionnaires survey was used to conduct an interpretive study. The aim of the questionnaire was to ascertain the academics' adoption and use of OA publishing. The questionnaire was divided into different sections for easy reading and time saving in the process of questionnaire completion. A Likert scale with four levels of possible answers respect to UTAUT model (from Strongly Disagree to Strongly Agree) was used. Questionnaires were distributed to a variety of academic staff in all the three different ownership status of universities (Federal, state, and private) in Nigeria. Federal universities were represented by University of Ibadan, state universities represented by Adekunle Ajasin University and private universities represented by Babcock University. The study focused on different age groups of lecturers and librarians (academic staff). A total of 337 questionnaires were distributed, of which 317 were completed usable for this study.

Data Analysis Instrument

Statistical Packages for Social Science (IBM-SPSS) version 19.0 was used to analyse the data collected through the surveys. The study applied multiple regression analysis with a focus on hierarchical regression to evaluate the relationships in the UTAUT

model and to test the hypotheses among the variables in the model. Hierarchical multiple regression (HMR) is a statistical analysis used to analyze and test hypotheses of theory driven research. According Pedhazur (1997) HMR is an appropriate tool for analysis when variance on criterion variable is being explained by predictor variables that are correlated with each other. The following section will illustrate the study analysis in more detail.

Background of the Participants

The data present in this section provides a summary of major characteristics of the academic staff (lecturers and librarians) that were surveyed with regards to gender distribution, age group, years of experience, educational qualifications and rank. The main target population was the academic staff members that have been publishing their scholarly work in peer reviewed journals. The questionnaire was directed to this set of academic staff to ensure necessary information is captured. The following Tables provide general overview of academic staff in three selected universities in Southwest, Nigeria:

Table2: Demographic information of the participants

	Variables	Frequency	Percentage(%)
Gender	Male	209	67
	Female	108	33
Age	20-30yrs	38	12
	31-40yrs	121	38
	41-50yrs	95	30
	51-60yrs	60	19
	61yrs and above	3	1
Experience	1-5yrs	75	23.7
	6-10yrs	140	44.2
	11-15yrs	83	26.2
	16-20yrs	16	5.0
	21 yrs and above	3	0.9
Educational Qualification	Bachelor	19	6
	Master Degree	95	30
	PhD Degree	203	64

Field Data, 2015

Reliability

The reliability of a measure refers to the degree to which the instrument is free of random error. It is concerned with consistency and stability of the measurement. Internal consistency tends to be a frequently used type of reliability in the IS domain (Sekaran, 2003). In this study Cronbach's coefficient alphas, which are calculated based on the average inter-item correlations, were used to measure internal consistency. Reliability coefficient was run on SPSS for each set of constructs and the results are presented in Table 2. Overall, the result shows that all alpha values of the study instrument are reliable and exhibits appropriate construct reliability.

Table 3: Cronbach Alpha Reliability Results

Constructs	No of Item	Question	Cronbach's alpha
Adoption and Use	10	Part B, Question 8 – 17	.859
Awareness	8	Part B, Question 18 - 25	.723
Attitude	6	Part B, Question 26 - 31	.745
Internet self-efficacy	5	Part B, Question 32 – 36	.749
Performance expectancy	6	Part B, Question 37 – 42	.903
Effort expectancy	6	Part B, Question 43 – 48	.861
Facilitating Conditions	6	Part B, Question 49 – 54	.837

Hypotheses Testing Results

Testing the hypotheses aims to determine which predictors (independent variables) provide a positive influence to the explanation of the dependent variables (Hair et al., 2010). In this study, hypotheses testing were conducted using IBM-SPSS version 19.0. Table 4 represents the results of testing the current research hypotheses.

The 'Conclusion' column indicates whether that hypothesis was: supported or not supported depending on the result coefficients beta.

Table 4: Hypotheses Testing Results

Hypotheses	Findings	Conclusion
H1(AW-AUP)	Beta= 0.37(significant)	Supported
H2(ATT-AUP) H2a:	Beta=0.41(significant) Beta=0.13(not significant)	Supported Supported
H3(PE-AUP) H3a; h3b: H3c:	Beta= 0.15 (significant) Beta= 0.26(not significant) Beta= -0.56(not significant) Beta= 1.60(not significant)	Supported Supported Not supported Supported
H4 (EE-AUP) H4a: H4b H4c H4d	Beta =0.01(not significant) Beta= 1.46(not significant) Beta= 0.14(not significant) Beta= 1.46(not significant) Beta= -1.08(significant)	Supported Supported Supported Not supported Not Supported
H5(ISE-AUP) H5a: H5b H5c H5d	Beta= -0.11(significant) Beta= 0.14(not significant) Beta= -0.27(not significant) Beta= -0.31(not significant) Beta= 0.51(not significant)	Not Supported Supported Not supported Not supported Supported
H6(FCs-AUP) H6a H6b	Beta= 0.13(not significant) Beta=0.18(not significant) Beta= -0.07(not significant)	Supported Supported Not supported

p-value <0.05

Discussion

This section discussed the results of the survey based on the finding of hypotheses results. As shown in Table4 the impact of the factors in the study model and its influences on adoption and use of OA publishing can be classified to significant and non-significant factors as follow:

Significant factors and moderators

Awareness (AW) had a positive influence on the adoption and use of OA publishing. The result emphasizes that awareness of OA remains significant and a strong factor of adoption and use of OA publishing. Attitude (ATT) of academic staff towards OA had a positive influence on the adoption and use of OA publishing and would be moderated by experience of Internet only though not significant; age, gender and educational

qualification were not being considered as important moderators. The result evince that attitude remains significant and a strong factor of the adoption and use of OA publishing. Performance expectancy (PE) had a positive influence on the adoption and use of OA publishing and would be moderated by age, experience and educational qualification, though experience with negative beta value did not support the hypothesis. Overall, this result shows that PE remains significant and a strong factor of behavioral adoption and use of OA publishing (Venkatesh et al., 2003).

Effort expectancy (EE) had a positive influence on the adoption and use of OA publishing and would be moderated by gender, experience and educational qualification. However, gender was not considered as important moderator in this connection. Internet self-efficacy (ISE) had a negative influence on the adoption and use of OA publishing and would be moderated by gender, age, experience and educational qualification. Facilitating conditions had positive effect on adoption and use of OA publishing and hence, supported the hypothesis.

Non-significant factors and moderators

Gender, age and experience were found to be insignificant in terms of moderating performance expectancy on the adoption and use of OA publishing by academic staff in Southwest universities in Nigeria. Efforts expectancy did not have a significant effect on adoption and use of OA publishing and its hypothesis was supported but it was moderated by gender and educational qualification only. Gender, age, experience and educational qualifications were found to be insignificant in terms of moderating effort expectancy on the adoption and use of OA publishing. Also, gender, age, experience and educational qualification were insignificant in terms of moderating Internet self-efficacy to adopt and use OA publishing. Facilitating conditions did not have significant effect on the adoption and use of OA publishing.

Conclusion

This study applies presently an adapted UTAUT model on adoption and use of OA publishing by academic staff in universities in Southwest Nigeria. Based on the data collected and the results of the analysis, it can be concluded that awareness, attitude, performance expectancy, effort expectancy and facilitating conditions have positive influences on user's adoption and use of OA publishing. However, Internet self-efficacy had negative influences on adoption and use of OA publishing and found to be significant and its hypothesis was not supported. In future work, the researcher would add social factor as independent variable into research model and consider the effects of other crucial constructs of the UTAUT model within the context of Nigeria. To be more precise and convincing, this work will continue and new findings will be anticipated.

Recommendations

This study has some limitations. Such limitations include its restriction to the Southwest of Nigeria. Despite the fact that the universities and participants selected from them were randomly, so as to enable valid generalization, the sample size nevertheless is relatively smaller than the whole population of academic staff in Nigerian universities, so generalization might not be absolutely valid. In light of this, it is essentially recommended that this study should be taken further by involving more academic staff in universities in other geopolitical zones (Northeast, South-south, South east, North-central, and North-west) of Nigeria. Such further studies should deeply examine how other vital variables like social factors and mediators influence academics' adoption and use of OA publishing in Nigeria universities.

With reference to the major findings of this study, the following are recommended.

- To improve academics' Internet self-efficacy, there is need for universities management to provide more of ICTs, Internet training, and upgrading of Internet facilities. This will enhance Internet skills and boost Internet self-efficacy
- Government, universities and individual partnership should provide more facilitating conditions like regular supply of power or making provision for alternative source of power like solar energy to power ICTs facilities. Technical support for regular maintenance of available facilities. This and others will enhance development of positive attitude by academic towards OA adoption and use of OA publishing.

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USERS' SATISFACTION WITH THE USE OF ELECTRONIC JOURNALS IN SELECTED UNIVERSITY LIBRARIES IN NORTH- EASTERN NIGERIA

Zainab Mohammed Abdullahi.

*Department of Library and Information Science,
Modibbo Adama University of Technology, Yola, Nigeria
+2348036055067, talk2zainabmautech@yahoo.com*

Abbas Adamu Lamido Gora

*Department of Library and Information Science,
Modibbo Adama University of Technology, Yola, Nigeria
+2348032095914, swiss04@live.com*

&

Usman Musa Dika

*Ramat Library,
University of Maiduguri, Borno State, Nigeria
08039789382,usmandika44@gmail.com*

Abstract

The study investigated users' satisfaction with electronic journal use in selected North-Eastern University Libraries in Nigeria. Correlational research method was adopted to determine the relationship between utilisation of e-journals and users' satisfaction. The study also adopted Krejcie and Morgan (2006) as sample frame to determine the sample size of one thousand, three hundred and seventy two (1,372) registered library users. The research instrument used was questionnaire. Demographic data of respondents were analyzed using descriptive statistics, while, Statistical Package for Social Sciences (SPSS) version 17.0 software was used for the inferential statistics. Pearson Product Moment Correlation (PPMC) coefficient was used to test Hypothesis 1-4 at 0.05 level of significance. The results showed that there was significant relationship between users' satisfaction and utilisation of electronic journals in the selected university libraries in North-Eastern Nigeria; hence users' were moderately satisfied. The study concluded that e-journals were moderately utilised for research, learning and information; the study recommended creating awareness, making them easily accessible, regular subscription to relevant, reputable, regular and up-to-date e-journals so that maximum users' satisfaction could be derived therein.

Keywords: Utilisation, Electronic Journals, Users' Satisfaction, University Libraries, North East

Introduction

North Eastern Nigeria comprises of six states of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe state. Each of these states has a federal and a state university. In addition to that, Adamawa and Taraba states have one private university each, bringing the total number of universities in the zone to 14. The university libraries in the North Eastern Nigeria like their counterparts in other zones are shifting their roles from the custodians of traditional information resources (printed materials) to the providers of

service-oriented digital information resources (electronic materials) (Quadri, 2012). One of the ways of achieving this is through provision of electronic information resources such as e-journals, e-books, e-databases, among others. A lot of researches have shown that Nigerian university libraries are subscribing to electronic journals. Such studies include Ozoemelem (2009; Egberongbe (2011); Komolafe – Opadeji (2011) and Ndubisi and Udo (2013), among others.

The significance of e-journals in Nigerian university libraries cannot be over emphasized. This is because, academic research, teaching and learning is greatly influenced by the current contents available in e-journals. Ani and Ahiauzu, (2008) assert that electronic information resources have gradually become a major resource in every university community. In academia, electronic resources especially e-journals are dominating the research activities of researchers; researchers have realised the importance of such resources (Hadagali, Kumbar, Nelogal and Bachalapur, 2012). They provide accurate and timely information, especially for academics and students who depend greatly on the e-journals for information to advance research and collaboration with other researchers around the world for intellectual growth (Ukpebor, 2012).

The need for utilisation of e-journals has been justified by many scholars. Studies by Okello-Obura and Magara (2008) revealed that library users derived a lot of benefits from electronic resources especially, e-journals, gaining access to a wider range of information and improved academic performance as a result of access to quality information. There is the need for library users to make use of e-journals to satisfy their information and research needs (Parvathamma & Reddy, 2009). Apanpa and Lawal (2009) opined that the use of technology and knowing how technology can support student's learning has become essential skills in today's world. Vasishta (2013) posited that the use of e-resources can revolutionize teaching and learning and could bring advances that would improve education dramatically. Ndubuisi and Udo (2013) in a study of motivation, challenges and strategies in the use of electronic information resources by postgraduate library users in South-East Nigerian Federal Universities, revealed that postgraduate students were motivated to use electronic resources such as e-journals in their university libraries because they found them to be more informative, easy to access and use, saves time, more useful and less expensive.

Satisfying users' needs in university libraries has been the primary objectives of libraries and librarians (Norliya, 2009). The study of Basil and Oyedun (2012) revealed that information resources, facilities, and services are the factors which influence users' satisfaction. Generally, universities in Nigeria admit new students into faculties with different information needs and demands every year. Users' satisfaction in terms of information needs is an important issue in the survival of any university library. User

satisfaction has been used frequently in most literatures to describe or measure how library products and services meet or surpass user expectation. Mohammed (2006) sees “user satisfaction” as the extent to which a library user information needs are fulfilled with the available service and information resources of a given library. Similarly, satisfying the requests of users implies providing the actual information or services that will meet the needs of an information seeker (Bassey, 2006). Therefore, this research was conducted to determine the relationship between users’ satisfaction with the use of electronic journals in selected university libraries in North-Eastern Nigeria.

Electronic journals are vital media that enhance academic and research works, thereby making education and knowledge acquisition better. Studies have shown that e-journals have been available in Nigerian university libraries, especially, as reported by Bassi and Camble (2011) that e-journals and other e-resources are identified as some of the electronic information resources available in the university libraries. Adeniran (2013) and Egberongbe (2011) showed that majority of lecturers, research scholars and students alike, prefer to use e-journals than printed journals, because they found it less time consuming. However, the availability of e-journals does not necessarily illicit utilisation in university libraries in Nigeria, which university libraries in North-Eastern Nigeria are inclusive. In spite of the availability and the perceived benefits of e-journals, Oyedapo and Ojo (2013) in a study on the use of electronic resources in Obafemi Alowowo University observed very low usage of electronic resources. The major reason that contributed to low utilisation of e-journals was limited searching skills. Other researches that reported underutilisation of e-journals include Baro, Endouware, Benake-Ebida, and Ubogu (2011), Ojo and Akande (2005), among others. Users cited lack of awareness of the existing e-journals, lack of accessibility to computers connected to internet; low internet bandwidth and unreliable power supply as reasons for low utilisation of the e-journals. Consequently, library users might not have derived adequate satisfaction with the utilisation of e-journals and this form the thrust for which this research was conducted, so as to determine the users’ satisfaction with the use of electronic journals in selected university libraries in North-Eastern Nigeria.

Research Questions

The following research questions guided the study.

1. What is the extent of use of e-journals in university libraries in North-Eastern Nigeria?
2. What is the extent of users’ satisfaction with e-journals use in university libraries in North-Eastern Nigeria?

Hypothesis

The following null-hypothesis was tested at 0.05 level of significance:

H₀₁ - There is no significant relationship between use and users' satisfaction with e-journals in university libraries in North-Eastern Nigeria.

Literature Review

Since the beginning of 21st century, studies began to indicate that electronic access to journals have been increasing in popularity among the users of the library. As a result of potential benefits offered by e-journals, many academic libraries have embraced e-journals and cancelled subscription to printed journals (Mutula, 2007 & Thanuskodi, 2012). Today, the use of e-journals is becoming important among researchers and academic staff worldwide vis a vis printed journals. For example, in higher education, scholarly e-journals have become essential tools for learning and research as they provide access to timely, high quality and relevant scientific information to scholars and researchers with a view to keep them abreast with new discoveries and developments (Madhusudhan & Chirra, 2009). Moreover, members of academic staff use e-journals to update their lecture notes as well as avoiding duplication of efforts. E-journals have added enormous resources to the collection and improved services of the library, enhanced access to journal literature and decreased demand for photocopy services as well as document delivery (Madhusudhan, 2010).

Studies have showed that there was relatively high utilisation of e-journals by academic staff who reported using e-journals on a daily or weekly basis for reference purposes in their research work (Khan & Ahmad, 2009). Baro, Endouware, Benake-Ebida, and Ubogu (2011) found that e-journals were underutilized in Delta State University. Another study conducted by Bansode (2013) revealed that 131 (49.63%) respondents make the use of e-journals 2/3 times in a week and the major category of the respondents comprises of research scholars followed by Post-Graduate students and faculties. Gupta (2011) at Kurukshetra University, India found that 66.7% of the faculties use the e-journals daily and few of the faculties using them either weekly or monthly. Ali and Faizul (2011) found that at university of Delhi nearly 50% of the research scholars claim to use e-journals daily.

Similarly, a study by Mirza and Mahmud (2012) revealed that users of Pakistani University libraries are moderately satisfied with the information they obtained from e-resources, such as e-journals. Another study conducted by Bansode (2013) revealed that out of 264 respondents, 214 (81.06%) respondents admits that their information requirements are fully satisfied with the e-journals subscribed by the library in university of Pune, Pune, India. A study by Bashorun, Isah and Adisa (2011) showed the performance of the library in satisfying lecturer's information needs via e-resources

and services. Another survey conducted by Kwafoa, Imoro and Afful-Arthur (2014) revealed that majority of the respondents were dissatisfied with electronic resources, they were of the opinion that electronic resources, even though beneficial, cannot replace print resources. Also, a study by Ezeala (2011) on user satisfaction with library resources and services in Nigerian Agricultural research institutes revealed that research officers were dissatisfied with the electronic resources in the libraries. Similarly, Ezeala (2009) studied the effectiveness of library resources in Agricultural Research Institutes in Nigeria. Findings from the study revealed that more than three quarters of the respondents find the libraries ineffective, as they indicated dissatisfaction with electronic resources and their library's collection. However, some studies have indicated underutilization of e-journals by academics. Baro, Endouware, Benake-Ebida, and Ubogu (2011) studied Delta State University and found that e-journal were underutilised. Oyedapo and Ojo (2013) observed that the major reason that contributed to low utilisation of electronic resources was limited searching skills.

A survey conducted by Sivathaasan (2013) on satisfactory level of undergraduate students with academic library in university of Jaffna, Sri Lanka revealed that there is a significant positive relationship between library facilities such as e-journals and undergraduate satisfaction. Furthermore, the results revealed that students' satisfaction is influenced by the library facilities. The survey revealed that 11.1% of user satisfaction is determined by library collections such as reference collections, lending collections, periodicals, archival materials, and electronic resources. Another study by Basil and Patience (2012) revealed that information resources (such as e-journals), facilities, and services are the factors which influence users' satisfaction.

Research Methodology

The study used correlational research design to determine the relationship between use and users' satisfaction with e-journals in university Libraries in North-Eastern Nigeria. The targeted population comprised five thousand three hundred and seventy nine (5,379) registered library users spread across five (5) university libraries selected based on resources (e-resources) available in these libraries. The five universities include University of Maiduguri, Abubakar Tafawa Balewa University Bauchi, Adamawa State University Mubi, Gombe State University Gombe, and American University of Nigeria, Yola. Stratified random sampling technique was used in drawing the samples for this study. The study also adopted Krejcie and Morgan (2006) table for determining sample size from a given population to determine the sample size. Accordingly, using stratified random sampling technique and Krejcie and Morgan (2006), the sample size for this study was one thousand three hundred and seventy two (1,372) registered library users. The research instrument used for this study was self-developed questionnaire. The

questionnaire had four-point type Likert scale of - High = 4, Moderate = 3, Low = 2, and Very Low = 1, to collect data from the respondents. Descriptive statistics was used for demographic information of respondents (sex, age, name of university, programme of study) and the two research questions, while, Pearson Product Moment Correlation (PPMC) Coefficient was used to test null Hypothesis at 0.05 level of significance. Because of the quantitative nature of the questionnaire, the responses were weighted per item on a Likert type 4 point rating- High = 4, Moderate = 3, Low = 2, and Very Low = 1.

Data Analysis and Results

Table 1: Response Rate of Copies of Questionnaire from Respondents

S/N	UNIVERSITY LIBRARIES	Copies of Questionnaire Distributed	Copies of Questionnaire Returned
1.	Ramat Library, University of Maiduguri, Maiduguri	317	281
2.	Abubakar Tafawa Balewa University Library, Bauchi	302	294
3.	Abdulrahman Ghaji Library, Adamawa State University, Mubi	254	232
4.	Gombe State University Library, Gombe	265	241
5.	Professor Robert A. Pastor Library, American University of Nigeria, Yola	234	216
		1,372	1,264

Source: Field work, 2015

Table 1 presents response rate in respect of one thousand, three hundred and seventy two (1,372) copies of the questionnaire distributed, filled and returned from the university libraries under study. 1,264 copies of questionnaire were filled, returned and found usable, making 92.1% return rate. The high response rate could be attributed to the fact that the respondents were all educated and the research assistants co-opted were all professionals working in the university libraries under study and were able to persuade the respondents in filling the copies of the questionnaire on wait and collect basis.

Table 2: Demographic Variables of Respondents

N = 1,264

Variables	Respondents	Percentage
Age group:		
17-24	266	21.0
25-34	331	26.2
35-44	353	27.9
45 and above	314	24.9
University Libraries:		
Ramat Library, University of Maiduguri, Maiduguri	226	17.9
Abubakar Tafawa Balewa University Library, Bauchi	302	23.9
Abdulrahman Ghaji Library, Adamawa State University, Mubi	254	20.1
Gombe State University Library, Gombe	265	21.0
Prof. Robert A. Pastor Library, American University of Nigeria, Yola	217	17.1
Programme of Study:		
Non-degree student	323	25.6
Undergraduate student	338	26.7
Postgraduate student	267	21.1
Academic / non academic staff	336	26.6
Gender:		
Male	832	65.8
Female	432	34.2

Research Question One: What is the extent of use of e-journals?

Table 3: Extent of E-Journals Use by Respondents

	Utilisation of E- Journals	High 4	Moderate 3	Low 2	Very Low 1
1.	What is the extent of your utilisation of e-journal for information?	412(32.6 %)	594(47.0 %)	169(13.4 %)	89(7.0%)
2.	What is the extent of your utilisation of e-journal for research?	365(28.9 %)	417(33.0 %)	284(25.2 %)	198(15.7 %)
3.	What is the extent of your utilisation of e-journal for assignment?	412(32.6 %)	594(47.0 %)	169(13.4 %)	89(7.0%)
4.	What is the extent of your utilisation of e-journal for teaching and learning?	312(24.7 %)	321(26.0 %)	329(25.4 %)	302(23.9 %)

Table 3 is showing the extent of e-journals use by the respondents. The overall result indicated that e-journals were moderately used by the respondents. Information attracted 594(47.0%) moderate, research attracted 417(33.0%) moderate, assignment attracted 594(47.0%) moderate, while; teaching and learning attracted 321(26.0%) moderate. The finding is in agreement with Baro, Endouware, Benake-Ebida, and Ubogu (2011) which found that e-journal were underutilized in Delta State University. This study is in disagreement with the study of Khan and Ahmad (2009), which found that there was relatively high utilisation of e-journal by academic staff who reported using e-journals on a daily or weekly basis for reference purposes in their research work. Most of the respondents who found e-journals to be either beneficial or highly beneficial mentioned that e-journals saved them time and found that it is relatively easy to use.

Research Question Two: What is the extent of users' satisfaction with e-journals use?

Table 4:Extent of Users' Satisfaction with E-Journals Use

	Satisfaction utilisation of e-journals	with High 4	Moderate 3	Low 2	Very Low 1
1	What is the extent of your satisfaction with utilisation of e-journals for information?	421(31.8%)	402(33.3%)	229(18.1%)	212(16.8%)
2	What is the extent of your satisfaction with utilisation of e-journals for research?	373(29.5%)	412(32.6%)	330(26.1%)	149(11.8%)
3	What is the extent of your satisfaction with utilisation of e-journals for teaching and learning?	387(30.6%)	473(37.4%)	215(17.0%)	189(14.9%)
4	What is the extent of your satisfaction with utilisation of e-journals for assignment?	404(31.9%)	550(43.5%)	250(19.8%)	60(4.8%)

Table 4 is showing the extent of users' satisfaction with e-journals in the study area. The overall result indicated that users' satisfaction with e-journals was moderate. Information attracted 402(33.3%) moderate, research attracted 412(32.6%) moderate, assignment attracted 473(37.4%) moderate, while; teaching and learning attracted 550(43.5%) moderate. This finding agrees with the finding of Mirza and Mahmud (2012) which revealed that users of Pakistani University libraries were moderately satisfied with the information they obtained from e-journals. Similarly, a study conducted by Bansode (2013) revealed that out of 264 respondents, 214 (81.06%) respondents admits that their information requirements are fully satisfied with the e-journals subscribed by the library in university of Pune, Pune, India. Another study by Bashorun, Isah and Adisa (2011) showed the performance of the library in satisfying lecturer's information needs via e-resources and services. However, this study is in disagreement with a survey conducted by Kwafoa, Imoro and Afful-Arthur (2014) which revealed that majority of the respondents were dissatisfied about the benefits of electronic resources. Also, a study by Ezeala (2011) revealed that research officers are dissatisfied with the electronic resources. In another study, Ezeala (2009) revealed respondents find the libraries

ineffective, as they indicated dissatisfaction with electronic resources and their library's collection.

Hypothesis Testing

Hypothesis was tested in this section using the Pearson Product Moment Correlation Coefficient at 0.05 level of significance.

Hypothesis: H₀₁ - There is no significant relationship between utilisation of e-journals and users' satisfaction.

Table 5: Relationship between Utilisation of e-Journals and Users' Satisfaction

		N = 1,264	
Variable	R	Utilisation of e-journals value	Users' P- satisfaction
Utilisation of e-journals	0.129		
		0.000	
Users' satisfaction			

**. Correlation is significant at 0.05 level (2-tailed), ($p < 0.05$)

The result in table 5 shows that there is a significant relationship between utilisation of e-journals and users' satisfaction. This is because the probability value ($P = 0.000$) is less than critical value at 0.05 level of significance ($P < 0.05$) at a correlation index $r = (0.129)$, meaning that utilisation of e-journals in university libraries in North-Eastern Nigeria is significantly related to users' satisfaction. Hence, the null-hypothesis which states that there is no significant relationship between utilisation of e-journals and users' satisfaction is rejected. This study agree with a survey conducted by Sivathaasan (2013) on satisfactory level of undergraduate students with academic library in university of Jaffna, Sri Lanka, the results of the Pearson's correlation revealed that there is a significant positive relationship between library facilities such as e-journals and undergraduate satisfaction. Furthermore, the results revealed that students' satisfaction is influenced by the library facilities. The survey revealed that 11.1% of user satisfaction is determined by library collections such as reference collections, lending collections, periodicals, archival materials, and electronic resources. This study is also in agreement with a study by Basil and Patience (2012) which revealed that information resources (such as e-journals), facilities, and services are the factors which influence users' satisfaction.

Conclusion

Based on the findings of this study, it was concluded that even though e-journals are available in the university libraries under study, the extent of use and users' satisfaction with the e-journals for research, learning and information was generally moderate. Similarly, e-journals use significantly correlated with users' satisfaction and thus users were moderately satisfied.

Recommendations

Management of university libraries in North-Eastern Nigeria should provide awareness about the availability of e-journals in the libraries. They should also make the e-journals easily accessible to users, in view of their significance among students, researchers and academic staff. This would stimulate the users to patronise the e-journals subscribed by the libraries. University libraries in North Eastern Nigeria should subscribe to relevant, reputable, regular and up-to-date e-journals that would satisfy the information needs of their library users. This would ensure that users are highly satisfied with use of the e-journals. Users should be encouraged to explore the opportunities provided by e-journals in searching relevant information for research, learning and information. They should be made to understand that the e-journals contain the most up-to-date information in their disciplines, which would go a long way in satisfying their information need.

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THE PERCEPTION OF INFORMATION LITERACY SKILL AMONG THE LIBRARIANS: A SURVEY OF UNIVERSITY OF LAGOS LIBRARY

Durodolu, Oluwale Olumide

University Library
University of Lagos
odurodolu@unilag.edu.ng, woledurodolu@gmail.com
&

Adekanye, Elizabeth Adetoun

University Library
University of Lagos.
eadekanye@unilag.edu.ng, tounadekanye@gmail.com

Abstract

Information literacy is elemental to quality library services, the knowledge of which will improve the service delivery and attract the members of the academic community to the library. The study examined perception of information literacy skill among the librarians using University of Lagos library as a case study. The study focused on three research questions and hypotheses to elucidate the opinion of library on information literacy and how it has helped the effectiveness of librarians. The study adopted post-positivist research paradigm in which quantitative and qualitative research method were used, data was gathered through questionnaires and content analysis. The target population were librarians and library officers who are purposively selected from the University of Lagos Library. The study established that Librarian and Library Officers possessed advanced level of perception of the need for information literacy, used library resources effectively; age group has significant effect on information literacy, librarians with higher qualification use library resources more than librarians with lower qualification and the level of information literacy of librarians also determine the extent of use of library resources. Female librarians are significantly more than their male counterparts. The recommendations focused on how issues and challenges could be approached positively to lead to better service delivery for a cosmopolitan environment like Lagos.

Keywords: Information Literacy, Librarian, Library Office, Information Communication technology, ICT4D, Lagos.

Introduction

The avalanche of information that an average individual is showered with in recent time is stunning. The upsurge of technology driven accessible information has made knowledge sharing overwhelming. But in some cases the overwhelming amount of information does not always translate into quality and usable information (White, 2009). Traditionally, accessing information can take a lot of effort, time and energy because it involves physically visiting information centres such as libraries, archives and museum. The library in the opinion of IFLA (2008) is a place and space for accessing dependable

information where the library collection developments are guided by time-tested ideologies and standards. The modern information environment requires the knowledge of information literacy for adequate knowledge for access and use of resources especially those available on the internet which is a complex information space where self-publishing is now a common practice as observed by White (2009) who argues that many of this self-publication have not gone through peer-review process and this could be a major source of misinformation and lowering reliability and dependability of information.

The role of teachers in disseminating knowledge and creating an atmosphere for lifelong learning has never been more crucial than it is now in an information and communication technology driven society. Hussain and Safdar (2008) pinpoint that the information age is an epoch renowned for provision of sound knowledge and matchless possibility for innovation, exchange of ideas, communication and discovery to strengthen the teaching learning process. In the opinion of Stasko (2013) information technologies facilitate promotion of opportunities of knowledge sharing worldwide, therefore in view of the above; the knowledge of information literacy is germane to modern teacher who desires effective teaching strategy befitting the modern learning environment. The available information in this modern time come from sources very difficult to verified and confirmed, these uncertainties have the capacity to cast shadow of doubt on the authenticity, validity, and reliability of information resources. Abubakar and Isyaku (2012) observed that doubtful quality and ever increasing quantity of information compounded the predicament of modern teachers who are supposed to guide students on how to expand the frontiers of knowledge that is anchored on fact and reality not fiction and speculation. The sheer large quantity of information does not automatically reflect the quality of information that is available to the citizenry. Consequently, the knowledge of information literacy becomes necessary for teachers who are eager to play a distinguished role in 21st century information usage.

In the observation of Leung (2010) posited that the new educational media has become a threshold for accessing and interacting with information, especially in the area of problem solving and critical thinking, these underscores the future prospect and importance of this innovative technology far above the knowledge of specific hardware or software, information literacy skill is an all-encompassing ability that aid all forms of literacy in which researching and communicating information in a digital atmosphere are as imperative as reading and writing were in earlier decade. Leung (2010) further observed that the major challenge confronting the contemporary students is the over abundant information of frequently questionable quality, in the same vein, teachers have come to realise the fact that way out of this predicament will be inadequate if attention

is focused on improving technology training, instead there is a progressively urgent steps needed for student to have the indispensable knowledge of information literacy skill, which will open doors of opportunity for them to be able to differentiate when information is required and have the capability to locate, evaluate, and effectively use information and apply those skills with the aid of modern technology.

Hussain and Safdar (2008) argue that the information flooded environment upholds new practices and ideas for education where the teachers are perceived as instructors who assist students in their studies rather than playing the typical role of giving instructions in the classrooms. This is so because students are now capable of independent access to information, they can collaborate and contribute to learning activities with their teachers and other learners in knowledge building and dissemination process even though they lack the ability to evaluate the sources of information properly. Since students can manipulate information constructively on their own, modern teachers should be alive to their responsibility and requirement of modern learning by embracing the knowledge of information literacy.

In the view of Ferguson (2003) one of the foremost challenges inhibiting the direct definition of information literacy is the multifarious interconnected skills that is required without which it will be difficult to describe the concept in a single sentence, Regardless of this, it is important to find a suitable definition that will mirror the importance of the concept to modern education, therefore, the National Forum on Information Literacy, a body established at the instance of American Library Association described information literacy as the ability to realise when there is need for information and to be able to discover, locate, evaluate and effectively use information for the purpose of problem solving. With close examination of the definition, one can conclude that for modern teacher to perform at optimal level the skill of information literacy is of paramount importance.

In the opinion of SCONUL (2011) information literate person is expected to exhibit a responsiveness of how to gather, use, manage, synthesise and create information and data in an ethical conduct and will have the information skills to do so effectively. In the perspective of Teachers, this expertise entails the ability to know the relationship between information and practical application in the classroom environment, and the dexterity and understanding to locate, appraise and use the information to the benefit of learners.

The role and responsibility of 21st century teachers have undoubtedly changed; there has been a momentous change over the last century from manufacturing to emphasizing

information and knowledge services, in the same vein, knowledge is increasing exponentially. Information and communication technology is at the heart of this development, how teachers become skilful and the nature of how work is conducted and the meaning of social relationships have changed. Collective decision-making, information sharing, collaboration, partnership, innovation, and speed are indispensable in today's endeavour. In view of the prevailing circumstances, students look forward to future that requires special skills, this position is accentuated by Pacific Policy Research Center, (2010) Nowadays, accomplishment is anchored on being able to communicate, contribute and utilise information to make sense out of complicated problems, and being able to adjust and improvise new innovation in reaction to new demands and changing circumstances, in being able to expand the power of technology to create new knowledge.

For teachers to play the pivotal role of educating facilitating and motivating students in the opinion of Gwen (2010) method applied must conform to 21st century technique of learning, teaching tools and resources must support learning strategies, that is teachers must adapt the curriculum and its requirements to instruct using digital tools.

Statement of problem

In the light of constant transformation in the information environment, information literacy skills have come to be recognised as a strategic tool for twenty-first century survival. Higher institutions, especially the university relies on the competence of librarian to expose them to quality information that can support teaching, learning and curriculum development. This study intends to investigate the perception of librarians about their awareness to their new responsibility in information management, especially electronically based information sources and how to utilise it for better performance in the academic environment. What is the perception of modern librarian about information literacy? To what extent can librarian use modern facilities to access information? Even though varieties of studies have explored different aspect of information literacy in relation to librarian, but evidently however there is paucity of research on the subject matter in relation to Nigerian environment, for this reason this study is imperative.

Research Questions

- I. What is the perception of librarian on the need for information literacy?
2. What is the information literacy level of librarians in University of Lagos library?
3. Which library resources do you use effectively?

Research Hypotheses

- H₀₁: Age group has no significant effects on information literacy level of librarians in University of Lagos.
- H₀₂: There is no significant relationship between educational qualification of librarians and library resources' use.
- H₀₃: There is no significant relationship between information literacy level of librarians and their use of library resources.

Methodology

This study was carried out for over two months (July and August 2014) using questionnaire as a means of data collection. The population of the study includes all academic librarians and library officers working in the University of Lagos Library. The research is quantitative in nature in which questionnaires were used to get the response of the academic librarians and library officers. The quantitative survey method was used in the study to respond to research questions in which librarians and library officers were purposively chosen for the study. The research instrument was given to the 22 librarians and library officers and 14 were returned representing 63.6%, simple random sampling technique was used in the selection; the librarians on study leave based were not selected because they were not available. The Questionnaire was divided into 2 parts. Part A captures bio-data of the respondents which includes: age, gender and years of experience. Part B contains inquiries that require information about how they perceive information literacy. Statistical Package for Social Sciences (SPSS) was used for the data analysis.

Interpretation of data and discussion of findings

Demographic Characteristic of Respondents

Table 1: Distribution of respondents based on gender

Variables		Frequency	Percentage
Sex	Male	5	35.7
	Female	9	64.3
	Total	14	100.0%

Table 1 shows that there are more female as 9 (64.3%) than male 5(35.7%) among the librarians in University of Lagos library.

Table 2: Distribution of respondents based on age

Variables		Frequency	Percentage
Age Group	16-20	0	0.0
	21-25	0	0.0
	26-30	1	7.1
	31-35	2	14.3
	36 and above	11	78.6
Total		14	100.0%

Table 2 revealed the frequency distribution according to age group. The result shows that majority of the librarians in University of Lagos library are within the age range of 31 years and above with 13 or 92.9% response rate.

Table 3: Distribution of respondents based on years of experience

Variables		Frequency	Percentage
Years of Experience	1 to 5yrs	7	50.0
	6 to 10yrs	2	14.3
	11 to 15yrs	5	35.7
	16 to 20yrs	0	0.0
	21 to 25yrs	0	0.0
	26 to 30yrs	0	0.0
Total		14	100.0%

Table 3 presents information on the working experience of respondents and it showed that all of the librarians within University of Lagos library have worked for only a period of 1-15 years.

Table 4: Distribution of respondents based on academic qualification

Variables		Frequency	Percentage
Qualification	NCE/OND	0	0.0%
	BLS/B.Ed	5	35.7%
	MLS/M.Ed	7	50.0%
	Ph.D	2	14.3%
Total		14	100.0%

Table 4 revealed that majority of the respondents working within University of Lagos library (7 or 50.0%) holds a Master of Library Studies/Master of Education degree while only 2 representing 14.3% hold PhD degree. This implies that majority of the people working within the university library possess the requisite qualification for working in a university library.

Table 5: Distribution of respondents based on possession of computer literacy skill

Variables		Frequency	Percentage
Computer literate	No	0	0.0%
	Yes	14	100.0%
Total		14	100.0%

Table 5 presents information on possession of computer literacy skill by the respondents and it revealed that all the respondents affirmed that they are computer literate. This implies that all the people working in University of Lagos library are computer literate.

Resolution of Research Questions

Research Question I: What is the perception of librarians on the need for information literacy?

Table 6: Librarians' perception of the need for information literacy

S/ N	Variables	Agreed	Undecided	Disagree	$\bar{x}$	SD	Ranked
1	I need information literacy skill to effectively use search engine	13(92.9%)	0(0.0%)	1(7.1%)	4.43	0.85	1 st
2	I need training on how to use academic electronic databases	13(92.9%)	0(0.0%)	1(7.1%)	4.14	0.77	2 nd
3	I need information literacy skill to effectively use a library	12(85.7%)	0(0.0%)	2(14.3%)	3.86	0.86	3 rd
4	I need information literacy skill to be an effective teacher	10(71.4%)	0(0.0%)	4(28.6%)	3.57	1.74	4 th
5	I need information literacy skill to effectively retrieve information in any source	10(71.4%)	0(0.0%)	4(28.6%)	3.50	1.69	5 th
6	I need information literacy skills to avoid plagiarism	10(71.4%)	0(0.0%)	4(28.6%)	3.50	1.69	5 th
7	I need special training on how to effectively use internet	9(64.2%)	0(0.0%)	5(35.8%)	3.29	1.20	6 th
8	I need to be trained on the proper use of the library	7(50.0%)	0(0.0%)	7(50.0%)	3.00	1.41	7 th

9	There is no relationship between my level of information literacy skills and job performance	4(28.6%)	0(0.0%)	10(71.4%)	2.14	1.61	8th
	Weighted Average Estimated Mean				3.49		

Table 6 presents information on the perception of librarians on the need for information literacy and it revealed the weighted average estimated mean of librarians' perception of librarians on the need for information literacy in University of Lagos library is 3.49 which is greater than the expected mean of 3.00. This implies that the librarians have positive perception on the need for information literacy skills by librarians. The positive perception of librarians about the need for information literacy is revealed in the positive responses recorded for each of the statements on the scale for estimating the need for information literacy among the librarians.

Research question 2: What is the information literacy level of librarians in University of Lagos library?

Table 7: Information literacy skill of Librarians

S/N	Variables	Yes	No	$\bar{\chi}$	SD	Ranked
1	Ability to identify potential sources of information	14(100.0%)	0(0.0%)	1.00	0.00	1 st
1	Ability to determine when information is needed	13(92.9%)	1(7.1%)	0.93	0.26	2 nd
2	Ability to access the needed information effectively and efficiently	13(92.9%)	1(7.1%)	0.93	0.26	2 nd
3	Ability to use information effectively to accomplish a specific goal	13(92.9%)	1(7.1%)	0.93	0.26	2 nd
4	Ability to integrate new information to existing body of knowledge	13(92.9%)	1(7.1%)	0.93	0.26	2 nd
5	Ability to evaluate information needs	13(92.9%)	1(7.1%)	0.93	0.26	2 nd
6	Ability to evaluate information and its services critically	12(85.7%)	2(14.3%)	0.86	0.36	3 rd
7	Ability to understand the ethical use of information	12(85.7%)	2(14.3%)	0.86	0.36	3 rd

8	Ability to develop successful search strategy	10(71.4%)	4(28.6%)	0.71	0.46	5 th
6	Ability to retrieved information in any format from sources	9(64.3%)	5(35.7%)	0.64	0.49	6 th
	Weighted Average Estimated Mean			0.87		

Table 7 presents information on the information literacy skills possessed by the respondents. It revealed ability to identify potential sources of information (14 or 100.0%), ability to use information effectively to accomplish specific goals (13 or 92.9%), ability to access the needed information (13 or 92.9%), ability to determine when information is needed (13 or 92.9%), and ability to integrate new information to existing body of knowledge (13 or 92.9%) as topping the list of information literacy skills possessed by respondents. This may mean that librarians in University of Lagos library possess the requisite information literacy skills hence they can be said to be information literate.

Research Question 3: Which library resources do you use effectively

Table 8: Effective use of library resources by librarians

S/N	Variable	Yes	No	$\bar{x}$	SD	Ranked
1	(Online public access catalogue (OPAC)	14(100.0%)	0(0.0%)	2.00	0.00	1 st
	Internet resources	13(92.9%)	1(7.1%)	1.93	0.26	2 nd
2	Currents Awareness Bulletin	11(78.6%)	3(21.4%)	1.79	0.42	2 nd
3	Computer System	13(92.9%)	1(7.1%)	1.93	0.26	2 nd
4	Digital Library	12(85.7%)	2(14.3%)	1.86	0.36	3 rd
5	Electronic Databases	11(78.6%)	3(21.4%)	1.79	0.42	4 th
6	Microsoft office tools	11(78.6%)	3(21.4%)	1.78	0.42	4 th
7	CD-ROM Search	11(78.6%)	3(21.4%)	1.79	0.42	4 th
11	Web 2.0	6(42.9%)	8(57.1%)	1.43	0.51	6 th
	Average Weighted Estimated Mean			1.79		

Table 8 presents information on the effective use of library resources among the Librarians of University of Lagos and it revealed online public access catalogue 91.4 or

100.0%), internet resources (13 or 92.9%), computer system (13 or 92.9%), digital library (12 or 85.7%), electronic databases (11 or 78.6%), Microsoft office tools (11 or 78.6%), current awareness bulletin (11 or 78.6%), and CD-ROM (11 or 78.6%) as major library resources being used by the librarians in University of Lagos library. This implies that the effectiveness of librarians in the use of library resources was rated high. Also, the weighted average estimated mean of librarians' effective use of library resources is 1.79 which is greater than the expected mean of 1.78. This may mean that the librarians in University Lagos do make effective use of library resources.

Research Hypotheses

H₀₁: Age group has no significant effects on information literacy level of librarians in University of Lagos

Table 9: ANOVA showing the effect of age group and information literacy skills of librarians

Age Range	N	Mean	Std Deviation	Sum of Square	df	Mean Square	F	Sig
26 to 30	1	22.00	0.00	13.318	2	6.659	33.57	0.000
31 to 35	2	26.00	0.00	2.182	11	0.198		
36 and above	11	25.72	0.46	15.500	13			
Total	14	25.50	1.09					

Table 9 revealed that age group has significant effect of information literacy skills of librarians in University of Lagos ($F_{(2,11)} = 33.575$, $P=0.000<0.05$). This may mean that age is a significant factor that determines the information.

H₀₂: There is no significant relationship between educational qualification of librarians and library resources' use.

Table 10: ANOVA showing relationship between educational qualification of librarians and library resources' use

Qualification	N	Mean	Std Deviation	Sum of Square	df	Mean Square	F	Sig
BLS/B. Ed	5	24.20	8.95	406.914	2	203.457	5.851	0.019
MLS/M. Ed	7	35.57	3.20	382.514	11	34.774		
P.hD	2	35.00	0.00		13			
Total	14	31.42	7.79					

Table 10 presents information on the relationship between educational qualification of respondents and their use of library resources. It showed that there is significant relationship between educational qualification of librarians and their use of library resources $F_{(2,11)} = 5.851$, $P=0.019<0.05$). This may mean that librarians with higher qualification (MLS/MEd and PhD) use library resources more than librarians with lower qualification (BLS/BEd).

H_{03} : There is no significant relationship between information literacy level of librarians and their use of library resources

Table 11: Summary of regression analysis showing relationship between information literacy level of librarians and use of library resources

Model	Sum of Squares	df	Mean Square	F	Sig
Due to Regression	28.629	2	14.314	5.209	0.026
Due to Residual	30.229	11	2.748		
Total	58.857	13			

Table 11 presents the result of the analysis of the relationship between information literacy level of librarians and their use of library resources and it revealed a significant relationship between information literacy level and use of library resources by librarians in University of Lagos ($F_{(2,11)} = 5.209$, $P=0.026<0.05$). This implies that information literacy level of librarians does determine the extent of their use of library resources.

Discussions of the findings:

Looking at the demographic variables, the study assigned highest value to female gender in the University of Lagos, which mean there are more female than male in the library, this correspond with the opinion of Nwezeh (2009) that says library is a profession popular among women in the UK and USA than men, but contradicts the opinion of Falaye (2004) that observed that librarian is a profession dominated by men. Results of findings from the study are in consistent with the findings and conclusions by earlier writers and researchers of similar topics. According to Doyle (1994) an information literate person in 21st century needs to possess information skills, an ability to recognize the needs for information, locate required information, formulate question based on information needs, identify potential sources of information, develop successful search strategies and access sources of information including computers based and other technologies. The individual must be able to evaluate information for practical application, integrate new information into an existing knowledge, use information in critical thinking and problem solving and also use information ethically and legally. Eisenberg (2008) noted that information literate services and instructions

are essential components of every 21st century programme whether offering direct instructions to users, providing skills-based functions on websites, delving one-on-one assistance, every information and library situation requires helping users to succeed through improving their information skills or understanding.

From the conclusion of Aharony and Bronstein (2014), librarians are aware of the concept and value of information literacy and are capable of handling information literacy. What is needed is an enabling environment by government approved standards and policy for survival in the knowledge society. They also strongly felt that information literacy is the responsibility of librarians but not added burden and that librarians have skills to handle literacy training which will not rub on routine duties of librarians.

This result is consistent with the findings of Arya (2014) and Karisiddappa and Rajgoli (2005) who reported that all the respondents in their studies have good understanding of the concept of information literacy and its importance in making user empowered in the information society. By the result of Anyaoku, et al (2015) respondents showed generally that they have a positive view of librarians' roles and capabilities in information literacy services. The respondents displayed this by scoring their skills highest on locating information by using library catalogues, encyclopaedia, indexes and abstracts to find information.

Conclusion

The study has been able to provide useful information on the perception of information literacy skill among librarians at the University of Lagos Library. The study has proved that information literacy (IL) is essential to the mission of any institution engaged in teaching, learning and research and that libraries have crucial role in this regard. In addition, IL programme in institutions would enhance librarians' knowledge in the building of a knowledge society. The study has also shown that the level of IL with librarians will determine the extent of use of library resources. Finally, the findings of the study would be described as a scholarly contribution on the perception of IL among librarians in Nigeria.

Recommendations

Based on the findings of the study, the following recommendations were made: The study found that the level of perception of librarians on the need for information literacy was to a great extent high. It is recommended that library management should provide training opportunities for librarian in order to update knowledge of librarians which inadvertently enhance their level of perception. Further, it was found that University of

Lagos librarians possessed the requisite information literacy skills. This is a plausible result which is against the prior expectation of the researcher. However, management should not relax on their oars but continually strive to raise the information literacy skills of librarians through workshops and in-service trainings from time to time. More so, the study revealed that University Lagos make effective use of library resources. It is recommended that management should provide state of arts infrastructure that will encourage librarians' continual usage of library resources. Also, the study found that demographic factors of age and educational qualifications of librarians significantly predicted information literacy skill of librarians. It is recommended that younger librarians and those with lower qualifications should emulate and understudy the older ones in information literacy skill acquisition. Lastly, information literacy of librarians was strongly connected to their use library resources. So, it is advised that management should not relent but provide more incentives that will continually drive librarians towards using library resources to enhance their performance and productivity on the job.

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RISKS FACTORS IN DECISION MAKING ASSOCIATED WITH THE INFORMATION SYSTEM ADOPTION: A REVIEW OF LITERATURE

Memudu, Suleiman Ajala

Dept. Of Information Communication Science, University of Ilorin

&

Tella, Adeyinka

Dept. Of Library and Information Science,
University of Ilorin

Abstract

This literature review focused on risks factors in decision making associated with the information system adoption. It drew on blends from the literature on IT innovation adoption theories and applies it in the context of IS security where, it has rarely been empirically investigated. In addition, it is noted that suggested profile helps to compare enterprises from different countries and their ability to adopt information systems that might be useful for authors in analyzing current adoption of information systems by enterprises and future perspectives in decision-making practitioners. Future studies are recommended to analyze the experience of different organisations in related information systems adoption since different organisations may have different experience in such systems adoption and usage.

Keywords: Risk factors, Decision making, Information system, Adoption, Information organisations/companies

Introduction

The process of decision making is one of the most complex mechanisms of human thinking, as various factors and courses of action intervene in it, with different results. Orasanu and Connolly (1993) define it as a series of cognitive operations performed consciously, which include the elements from the environment in a specific time and place. Narayan and Corcoran-Perry (1997) consider decision making as the interaction between a problem that needs to be solved and a person who wishes to solve it within a specific environment.

There are several steps that must be followed in order to arrive at a decision: one must realize that it is going to be necessary to make a decision, determine the goals to be achieved, generate alternatives that lead to attaining the proposed goals, evaluate whether these alternatives meet one's expectations and, lastly, select the best alternative, the one that implies an efficient global result (Schryen, 2011). This entire process is affected by personal and environmental variables. In effect, individuals may make different decisions depending on whether they feel their boss is observing them, on the

amount of information they have, or if certain motivations play a relevant role in their lives.

The traditional process of purchasing information systems by acquiring its license did not have any alternative until 1998, when the open source phenomenon appeared. Until then, information systems or software was seen as a product that we have to pay for, just like we would for any other material object (Schryen, 2011). The open source information systems movement led to the birth of open source software (OSS) (Perens, 1999). "OSS" means that the source code is freely available and can be adapted to match potential new needs. It is often defined as system or software that can be freely modified, freely distributed, technologically neutral, and grants free subsidiary licensing rights (Perens, 1999). In today's modern economies, information organizations have the choice between acquiring information systems software by paying for its license, building customized software or adopting an Open information systems product that is free of charge. In this context, software or information systems adoption is seen in large part as a risk-driven process (Shaikh & Cornford, 2012). Indeed, in the OSS case, the open source community, responsible for the design, development, and maintenance of an OSS project may disband and thus impact the future of the project itself (Germonprez et al., 2012). Many other risks present in the open information systems context have been identified in past research: security risks (Herbsleb, 2002), lack of expertise (Krishnamurthy, 2003), compatibility (Guth, 2006), ownership (Kenwood, 2001), or training issues (Forrester, 2004). Many of these risks stem from the infancy or instability of an open information systems community, which fails to provide real value to the information organizations when compared to proprietary solutions.

A study from (Schweik & English, 2012) found that out of 145,475 projects from the popular OSS portal Sourceforge.org, 46% a sample of an information systems were abandoned in the initiation stage and only 17% were successful (one of the successful project common characteristic is a "relatively clearly defined vision and a mechanism to communicate the vision early in the project's life"). The reasons behind these significant numbers of failures in the information systems project lifecycle lay in the origins of the open information systems model, which was conceived on the foundations of freedom (freedom to run, copy, distribute, study, change, and improve software) and choice (choice to distribute your version or not) (Scacchi, 2007). But freedom and choice introduce risks (Gartner, 2011). The risks that are introduced may have disastrous consequences leading to expensive failures (Franch et al., 2013). The lack of good risk management was highlighted as one of the key points to take into consideration when implementing an information systems product (Gartner, 2011).

Free information system adoption is booming with some software segments, such as the web server market; OSS technology is the leader in server software count (e.g. Netcraft, 2014) a web server survey found that 54% of all worldwide servers are using an OSS product such as Apache or nginx). Also, Strategy analytics (2013) announced that the Android operating system (an OSS product) reached a new record of 81% global share in smart phone market. These facts would suggest that in the enterprise context, OSS is being broadly adopted. However, it seems that enterprises are more cautious when it comes to OSS adoption. This is partly explained by the fact that enterprises are not performing any real cost-benefit analysis (Ven, Verelst, & Mannaert, 2008). In other words, the OSS evaluation process can be very time consuming and heavy and these hidden costs are just one of the potential technological risks (Tiangco, Stockwell, Sapsford, Rainer, & Swanton, 2005). In order to minimize these risks, often, it is necessary to go through the phase of end-user training (Morgan & Finnegan, 2007a) and getting the professional support (Fitzgerald & Kenny, 2004). The quality of the OSS product was also questioned by researchers (Fitzgerald & Kenny, 2004; Rudzki, Kiviluoma, Poikonen, & Hammouda, 2009; Ven et al., 2008) along with issues of 'compatibility' and 'lack of standards' (Ågerfalk, Deverell, Fitzgerald, & Morgan, 2005; van Rooij, 2007). Several study findings have revealed that the adoption of free information systems is still minimal. For instance, a CNBC (2013) report indicates that the closed-source software system is still the predominant operating system for tablets used at work, with 55% of the market share compared to 25% of the market share for Android. Also, according to a Hubspan (2011) survey, Linux has only 9% of the market share for enterprise desktop operating systems. This slower enterprise free information system adoption trend is mostly explained by the fact that quality and security have been important topics of dispute and debate between the open and closed source opponents (Gartner, 2014). From an enterprise perspective 64% of enterprises still view security as a major obstacle to free information system IS adoption (Deloitte, 2012). This paper, follows ISO's definition of security risk which defines it as "the potential that a given threat will exploit vulnerabilities of an asset or group of assets and thereby cause harm to the organization" (ISO, 2008). Harm usually leads to several different risks for organizations that are, ultimately, all about the financial, reputational or legal consequences that organizations look to avoid. More precisely, in the OSS context the IT security risk can be related to, for instance, hidden costs (e.g. time spent performing an OSS evaluation can be very lengthy).

In general, previous studies have studied different potential risks behind information system adoption, but most of these studies face generalizability challenges since either they were focusing on a single (specific) information system product in a particular organization/country (Goode, 2005) or their research setting was public administration

(Federspiel & Brincker, 2010) and software companies (Hauge, Ayala, & Conradi, 2010). Indeed, because Ven and Verelst (2012) found that research in this area is still fragmentary and the corresponding results are inconclusive, this has led to ambiguity about the factors that influence decision-makers.

Therefore, there is mix-up in the holistic view of the perceived IT security risk factors that influence the IT executive's adoption decisions. Management of IT security risks in the information system adoption context implies the use of specific risk management procedures and policies aimed at risk reduction. The goal of this research paper is to analyze the management of IT security risk in the context of IS adoption practices by explaining and providing factors that help reduce perceived risk in the IT executive's decision-making process.

Risks that information organizations face are larger and more varied, and have more global effect. These risks relate not only to reporting and compliance; they also include strategic and operations risks. Increased corporate strategic alliances and business partnerships also create growing risk interdependencies. Although risk assessment processes generally have improved, inadequate risk reporting in some organizations has led to a failure to fully integrate identified risks into strategic and operational decisions. When planning a merger or an acquisition, for example, how confident can one be about the expected gains without carefully considering all potential risks, including their assessed magnitude and probability of occurrence? Decision-makers need to understand the various organizational risks, to minimize mistaken investments that can cause significant organizational costs. Managers need good risk reporting systems to integrate risk evaluation into (a) their operational and capital investment decisions, (b) review of performance, and (c) compensation decisions. Improved organizational risk assessment and internal risk reporting is critical also for senior management and boards of directors, who are responsible for carefully establishing and reviewing corporate processes for identifying, assessing and managing risk.

Silic and Back (2015) assumed that better understanding of the IT security risks related to information system adoption in the information organisation is of the highest importance and that it has not received adequate research focus thus far. To fill this identified research gap, this review aims to identify the risk factors that influence the adoption intention in the context of information systems. This paper will introduce the information systems Risk Adoption model, which will provide theoretical foundations for information systems adoption. Furthermore, the paper will explain the underlying risk factors and relate them to the decision-making process during information systems adoption.

Literature Review

A better understanding of the risks factors related to information systems adoption is an important aspect in the business decision-making process. Knowledge about the associated risks and their better management would allow faster, better, and easier integration of an information systems product into an enterprise's information systems (Silic & Back, 2015). So far, scholars have mostly focused on the IT security-related risks of one single OSS product or just a few OSS products only (Alhazmi, Malaiya, & Ray, 2007; Neuhaus, Zimmermann, Holler, & Zeller, 2007).

The Information Systems Adoption

Information systems (IS) are defined as the complementary networks of hardware and software that organizations use to collect, filter, process, create, and distribute data. Each specific IS aims to support operations, management and decision making. In a broad sense, the term is used to refer not only to the information and communication technologies (ICT) that organizations use, but also to the way in which employees interact with them seeking to support business processes. Some authors make a clear distinction between IS, ICT, and business processes. IS typically include an ICT component but are not purely concerned with ICT, which focus on the end use of technology. IS are also different from business processes. So, IS help to control the performance of business processes?

Information systems (IS) adoption is a process during which a problem is solved through the assessment and evaluation of alternative solutions. Information System adoption models recognize both organizational and extra-organizational factors (Del Aguila-Obra & Padilla-Melendez, 2006). A brief review of literature provided below discusses some of the most important factors that affect IS adoption decisions.

Methodology

Initial literature search was performed to identify theoretical models utilised in examining adoption of IS. Based on this search results, the study then identified the most commonly used innovation adoption and user acceptance models. Following Hameed and Arachchilage (2016), the IS security adoption studies that used IS innovation adoption models in their empirical investigations were selected. The IS security literature extracted includes studies conducted for both individual and organisational contexts. The most prominent innovation adoption models used in IS security adoption were then drawn together, to crystallize the conceptual model presented in this study. In addition, the factors from different categories that were examined in the IS security adoption literature were extracted.

Models of IS Innovation Adoption

There have been significant amount of research conducted in examining the process and the factors influencing the adoption and user acceptance of innovations in organisations. However, there seem to be limited or no organisational innovation adoption theory in existence for researchers to utilise (Hameed et al. 2012a). Hitherto, researchers have been utilising several theories and theoretical models to explain the adopter's attitude, innovation adoption behaviour and various determinants in different contexts of IS adoption. In addition, innovation adoption research has introduced several theoretical models related to the adoption and user acceptance of innovation in organisations (Hameed et al. 2012a).

In this section IS adoption models are quickly reviewed. First, Rogers' innovation adoption model (1995), where capable of adopting organization to apply the technology is a secondary consideration in the model. Rogers suggests that novelties adoption can be the result of the effects of five groups of determinants. The first group focuses on the perceived attributes of novelty. These include relative advantage (how much better the technology is comparing to it supersedes), compatibility (how well it meets needs), and simplicity (how easy the technology is). Second, it is MOA (MOA: motivation, opportunity, ability) model, where the extent of innovation adoption is primarily determined by individual organization rather than the technology. Borrowing from individual level adoption models, theorists have attempted to describe technology adoption by placing their emphasis on organizational factors (Azadegan & Teich, 2010). The underlying factors for these models can be categorized into such groups: the organization's motivational factors; the organization's ability factors; and other external factors.

A criticism of classical adoption theories is that they tend to neglect market and industry characteristics as important factors in the adoption decision. An exception is that of the TOE (TOE: Technology, organisation, environment) model. It distinguishes how the industry, competitors, government and other near and far institutions can influence the adoption decision (Azadegan & Teich, 2010).

Technology Acceptance Model TAM2 was developed specifically to predict who is most likely to accept new information system in a workplace environment. It is an adaptation of the theory of reasoned action, in that the model posits that beliefs determine behavioural intentions, which determine behaviour. TAM2 differs from the theory of planned behaviour in that it accounts for the fact that in organizational settings the adoption of new information system is not determined solely by the employees' beliefs.

Even when employees use the information system supplied to them, human error is a large component of the success or failure of any adoption initiative. Rarely organizations remain competitive because they make large investments in information systems. Most of the system performance shortfalls are the result of behavioural errors rather than hardware or software deficiencies (King & He, 2006). These shortfalls often stem from users failing to use the new information system the way the decision-makers envisioned. In most cases, employees would increase their performance if they would fully utilize information system that has already been adopted by their organization. Besides justifying the sizable investment in information system that has been adopted, organization leaders must justify the downtime that occurs as a result of implementing that change.

There has been discussion regarding the most appropriate measure of information system acceptance (Sun & Zhang, 2006). TAM2 can predict both behavioural intention to use the technology and also actual use after adoption. These two indications of acceptance are conceptually different. The alternative measure of future usage depends on a number of adoptions and history factors that may or may not be directly associated with characteristics of the information system itself.

Abrahamson (1991) discusses the adoption of inefficient information systems that are expensive to implement and don't add value to the enterprise. The justification of any information system in economic terms is problematic, however, in part due to unknown implementation costs, which can be much greater than the cost of the information system itself. Fichman (2004) presents a framework used to evaluate the economic value of new information system.

In literature, authors; Thatcher et al. (2006) described the degree to which various organizational, industrial, governmental and cultural factors influence IS adoption decisions. Governmental factors include government regulations and industrial factors – industry cycles. Cultural factors are the main driver of adoption decisions but it is clear that cultural factors can help us better understand how the confluence of organizational, industry and governmental factors do indeed influence decision making. In the individualistic culture of the United States, a “technology champion” often drives the IS adoption. This is very different from Chinese cultures where IS adoption is more of a collective effort driven by a confluence of government, industry, and management initiatives.

In other words, the role of culture in IS adoption decisions inside countries may find no effects of culture until one differentiates between different industries at national level.

Thatcher et al. (2006) find out that the adoption of business-to-business (B2B) information systems by large customers has driven the adoption of these by their suppliers. In the United States, the electronics industry has also been more advanced than the textile industry in terms of linking enterprise resource planning (ERP) systems between organizations. Firms also are increasingly deploying open source information systems due to their advantages such as flexibility, knowledge creation, performance, and cost-saving (Qu et al. 2011). Qu et al. (2011) expand the literature by distinguishing information systems adoption experience at two levels – company level and industry level and show such necessity.

Lee et al. (2010) provides a framework through which technology adoption behaviour can be examined systematically at the dyadic level of B2B relationships. This framework includes the multi-level characteristics of buyer-seller information system adoption. Lee et al. (2010) argue that a buyer-seller information system adoption can serve as a resource that promotes cooperation and collective actions between current or potential suppliers and customers. Competitive pressure for adopting a buyer-seller information system refers to the capabilities of their competitors (Lee et al. 2010). In addition, the adoption of buyer-seller information system has positive externalities: the obtainment of potential benefits depends on the collective actions of other companies. This means that potential benefits increase if more companies adopt the same or compatible information systems (Lee et al. 2010).

Successful technology adoption depends on multi-dimensional perspective, including those related to the adopter, to the information systems, to the provider and the network within which they operate. Without careful consideration of these factors, effectiveness of benchmarking of information systems adoptions may be remiss of predictable outcomes (Azadegan & Teich, 2010). How organizations assess the benefits (and risks) associated with technology adoptions is dependent on the type of technology and its lifecycle.

Sääksjärvi et al. (2011) raise question about adoption of IS with dual-functionality and multiple-functionality. Authors mention that high-tech IS are increasingly becoming multifunctional. They increase confusion, frustration and indecision thinking about new IS adoption. Organization's readiness which includes its resistance to innovation, technology sophistication and the availability of finances in adopting new technologies should be less influential. The theoretical arguments made by systems theorists with those suggested from adoption theories to note three key factors to affect technology adoption: network size; network inter-connection; and technological infrastructure. For

example, network factors are technological infrastructure and the level of collaboration between network members.

At the same time, the relations between network partners play a role as a social control mechanism that governs partnership behaviours at the dyadic level, whereas a low level of relations is characterized by weak ties. Weak ties are more likely to be not stable bridges for possessing unique information compared to strong ties. However, enterprises connected with weak ties are exposed to the risk of opportunistic behaviours by their partners. For instance, they are more likely to exit the relationship in order to solve problems than to seek solutions within the current partner relationship. Such interactions between buyers and sellers are very important in the process of a new technology adoption (Lee et al. 2010).

The need to adopt new technology can also occur due to competitive reasons. The competitive pressure for adopting a buyer-seller technology refers to the level of buyer-seller technology capability of its competitors. Studies show that despite the lack of internal needs concerning new technology adoption, many firms actively adopt automated data exchange solutions or ERP software packages to respond to the various forms of competitive pressures. The firms are evaluating between the risk of losing competitive advantage and opportunities in case they are late with new technology adoption (Lee et al. 2010).

Strüker et al. (2010) suggest discussing the innovation-push (IP) and need-pull (NP) concepts to explain behaviour in the adoption of new information systems. The smaller organizational size can be an advantage for the adoption of information systems. A crucial prerequisite is that the adoption of information systems significantly affects business processes and organizational structure. Small and medium size enterprises have a relative advantage because of lower complexity of organizations. But comparing with large enterprises small and medium size (SMEs) enterprises typically exhibit lower financial resources and the lower number of cooperating suppliers and customers.

Risk, Risk Attitude, and Decision Processes

Risk implies a degree of uncertainty and an inability to fully control the outcomes or consequences of such an action (Arsham, 2015). Risk or the elimination of risk is an effort that managers employ. However, in some instances the elimination of one risk may increase some other risks. Effective handling of a risk requires its assessment and its subsequent impact on the decision process. The decision process allows the decision-maker to evaluate alternative strategies prior to making any decision. The process is as follows (Arsham, 2015):

1. The problem is defined and all feasible alternatives are considered. The possible outcomes for each alternative are evaluated.
2. Outcomes are discussed based on their monetary payoffs or net gain in reference to assets or time.
3. Various uncertainties are quantified in terms of probabilities.
4. The quality of the optimal strategy depends upon the quality of the judgments. The decision-maker should identify and examine the sensitivity of the optimal strategy with respect to the crucial factors.

Whenever the decision maker has some knowledge regarding the states of nature, he/she may be able to assign subjective probability estimates for the occurrence of each state. In such cases, the problem is classified as decision making under risk. The decision-maker is able to assign probabilities based on the occurrence of the states of nature. The decision making under risk process is as follows:

- a) Use the information you have to assign your beliefs (called subjective probabilities) regarding each state of the nature, $p(s)$,
- b) Each action has a payoff associated with each of the states of nature $X(a,s)$,
- c) We compute the expected payoff, also called the return (R), for each action $R(a) = \text{Sums of } [X(a,s) p(s)]$,
- d) We accept the principle that we should minimize (or maximize) the expected payoff,
- e) Execute the action which minimizes (or maximize) $R(a)$.

Prior research shows that perceived risk influences decision-making (e.g., Tversky & Kahneman 1986). Several studies in the JDM literature find that higher risk is associated with deeper cognitive processing. For instance, Ferrer & Klein (2015) show that when risk perceptions are higher, the salience of negative consequences increases. Studies in psychology (Alba and Hutchinson 1987; Chi et al. 1988; Choo & Trotman 1991) find that deeper cognitive processing is more effectively leveraged into task performance among individuals with greater relevant expertise. Consistent with this notion, Connolly and Gilani (1982) concluded that information acquisition is used as a risk-reducing strategy, perhaps because people seek more knowledge in an effort to rule out some of the possible negative consequences that risk has induced them to consider.

Factors Influencing the Decision Making Process in Information Systems Adoption

Overload of responsibility: it is rather competitive world and thus one must understand that the overload of work is responsible for the decision making process also goes through the same challenge where they have ample work that cannot be much handled without the involvement of the risk in the same. With the work being more than what one can handle, the factor of risk becomes very much evident in the decisions that are made and thus can impact the process of decision making for every important decision as well.

Role conflict: This can be said to be another impact which does bring in much of a risk in the decision making process. This can also be said to be overriding of one's decision by another on the basis of the role. The management is also divided under different roles and responsibilities that are placed on the management system and thus becomes rather difficult to be able to override a decision taken by someone who is in more position of authority and power than oneself. This can be said to be challenging as it only helps in bringing much more responsibility on the people who are involved in the same. One need to be assured that the role that they are playing in the organisation will definitely be impactful on the decision they make and this will eventually impact the business in some either positive or negative way.

Participation in the decision making process: The management team in the information profession is believed to be among the people who the major participants of the decision are making process. Thus, their involvement helps in confirming that they are the members who are actively participating in the similar decision making process with the understanding that the level of the participation is on the similar ground. The participants and their handling skills are considered majorly while decisions are made.

Cultural differences: when a business decides on operating on foreign countries which means that when the business turns, then it operates on foreign lands and thus it is very natural to face the greatest challenge of cultural difference. We have although cut through the geographical boundaries but still the challenge which the cultural throws need to be dealt by us. Different countries are bound to have a different cultural environment and thus the works of the same values are also very naturally adapted in following their cultural beliefs. Neutralizing the workforce and bringing it on common grounds can be said to be very challenging for the management of the business. When a brand established itself in another country, it needs to maintain its brand values and norms for its further expansion. Thus, the diversity in the cultural norms needs to be understood in order to help it gain more potential in the business world. Working with diverse workforce can be interesting but setting of one's value and work culture needs

to be met as a challenge and this has to be done when one is aware of the cultural norms that the workers do follow and thus the management policies are strategized keeping them in mind. One examples can be taken where the business cannot sell beef products in the Indian market as it is not much accounted for and thus for the firms dealing in the same, it is essential to keep these factors in mind (Witiger, 2012). This also can be said to be a factor which helps in bringing a much of a difference in the process of decision making and also can be the risk which is involved in the same.

Legal Challenges: The legalities in business are very essential and thus can be said to be a pressing point and a challenge for business. Suppose one has a business which can be expanded on ground and then if any legal issues arise, the business management must be aware that the jurisdiction that would be followed for the same would be forms that grounds. Thus, while setting up business, sit become s all the more important to know the legal rules and regulations of the country and thus keeping them in mind the business must be advanced. The management must be aware of all the labor rights and the tax issues that can be raised o n the foreign land. It is important to understand them before one enters them. The risks that would be involved with the same must also be considered as the company is operational in much international market and this it is important that the decisions made by them are able to revolve around the laws of these international market as well.

Economic challenges: The business needs to face economic challenge which pertains to their growth and development factors economically. Like a business in the Asian countries must be aware that sales boom will not be to an extent in the Charismas season as it is in the USA. The charges of labor force must also be well evaluated and the financial standing of the country must also be seen before decision of starting a business is laid there. In a country where majorly has a low standard of living a brand selling high precede goods will not be able to sustain its business possibilities. Thus, these aspects must be kept in mind by the management team. The targets also vary in this aspect in the business.

Technical challenges: Although technology has grown but there are associated challenges. The biggest technological challenge that can be said to be seen in the business based on the fact of communication. The business solely depends on technology as a medium of communication and thus strong technological support is required in this aspect (Daniels, Radebaugh & Villareal, 2007). It helps the business to grow in a much better manner if the communication medium is working in its best manner but on the other hand, if there is glitch in the communication, then the business can even suffer many losses. To face the challenge, it the responsibility of the management system to be able to develop a very strong technical system with eventual

backup facility which can always help the business working upfront rather than running into any loss.

Target market; each country can be said to have a different target market ahead of them. The people of the country who are the customer can have a different set of choice which works best for the business if understood in the right manner. This means that researching on the target market can be an important aspect that helps the business to grow and develop and thus it is very important that the management has a wide knowledge of the target customers that they are dealing with so as to be able to gain the target that they are setting up for themselves (Henist & Zelmer, 2010). This can also be seen from the aspect that the target market would be able to generate much better outcomes for the business and management will be able to bring more development in the business field (Cole, 2011).

Sustainability: The factors of sustainability also need to be focused upon. Each and every business needs to be focused on the factors which can help it sustain on grounds. The management must meet the set targets for sustainability and thus must take responsibility of their business regulations as per the market demands (Luthans & Dob, 2015).

Business attitude: The business attitude must be very much in sync with the market where the business is operational. The etiquettes and the habits of the consumers must be imbibed by the management for better results. There could be markets which appreciate a certain gesture and thus keep itself very focused and involved in the charging process. They must be open to learning the etiquettes of the business in the foreign lands as this helps them to be able to make more informed terms of business with their prospective clients.

In addition to the above, Burinskiene and Pipiriene (2013), as well identified additional potential barriers concerning the adoption and application of information systems:

- Costs and benefits. It could be situations then benefits derived from adoption exceed costs to implement information system. In order to reap the full benefits information system has to be integrated into the company's existing technological infrastructure, internal business processes and cross-company processes as well;
- Security. For the prevention of unauthorized executions of sensitive information in the case of cross-company information exchange e-signature or other security tools could be implemented.

- **Functionality.** Technical functionality of information systems is an important potential barrier. For example, the management of large amounts of data can impose a burden which is too high for implemented information system (Strüker et al. 2010).

As a result, factors that influence the adoption of different IS may enhance the understanding of relationships and therefore allow for more effective benchmarking. Furthermore, organizations may follow industry expectations to adopt a technology. These factors alone, or in combination, may influence the adoption effects for various technologies differently.

Conclusion

This review of literature has focused on risks factors in decision making associated with the information system adoption. The study contribution to knowledge includes an enhancement of understanding of IS security adoption and implementation process in organisations. It draws upon and blends from the rich literature in IT innovation adoption theories and applies it in the context of IS security where, it has rarely been empirically investigated. To surmount the shortcomings of individual IS innovation adoption models such as the DOI and TAM; the proposed model combined a number of innovation adoption models. Merging different innovation adoption models allows the individual model to complement each other, hence, making structure of the proposed model more robust.

In Addition, it is noted that suggested profile helps to compare enterprises from different countries and their ability to adopt information systems and might be useful for authors analyzing current adoption of information systems by enterprises and future perspectives and decision-making practitioners. Future studies are recommended to analyze the experience of different organisations in related information systems adoption since different companies may have different experience in such systems adoption and usage.

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CONSTRUCTION AND DEVELOPMENT OF DEMOGRAPHIC SCALE TO MEASURE SOURCE CREDIBILITY

Saudat Salah Abdulbaqi

Department of Mass Communication,
+2348034508413;
Email: sau_baqi@yahoo.com

Che Su bt Mustaffa

Department of Communication,
School of Multimedia and Communication Technology, Universiti Utara Malaysia,
06010 Sintok, Jitra, Kedah; Ph +60194416853; Email:chesu402@uum.edu.my*

Abstract

This study developed a scale for measuring the impact of demographic characteristics of the source on receiver's willingness to comply with disseminated message on maternal mortality. The inclusion of perceptions of gender, age and socio-economic status of the source to source credibility study gives a very sound appreciation of the influence of visible characteristics of the source on attitudinal and behavioral changes towards the content of disseminated messages. Accepted psychometrics scale-development procedures were followed that rigorously tested a large pool of items for their reliability and validity. A total of 365 respondents were involved in this study. Data for the study were gathered through quantitative surveys, from men and women of childbearing age in north-central Nigeria. Using exploratory and confirmatory samples, the current research came up with a 16-item semantic differential scale to measure the influence of the demographic characteristics of the source on message effectiveness. Consistent with source credibility theory-based studies, findings in this study has justified the assertion that an increase in the positive perception of characteristics of the source leads to an increase in message effectiveness.

Keywords: Perception of demographic credibility, Instrument development, message effectiveness, maternal mortality

Introduction

Credibility refers to a person's perception of the truth of a piece of information. It is a multi-dimensional concept that serves as means for the receiver of the information to rate the source or transmitter of the information in relation to the communication. A detailed review of source credibility literature over the years reveals a large amount of research into the effect of source credibility in various disciplines. (See for example, Hovland & Weiss, 1952; Koslin, Stoops, & Loh, 1970; Dutta-Bergman, 2003). However, except for a few studies (like Freiden, 1984; Pearson, 1980; Engstrom & Ferri,

2001 and Markham, 1988) the demographic features of the source are rarely considered in examining credibility (Pornpitakpan, 2004).

Interdisciplinary studies have revealed that gender differences are relevant in virtually every human activity. Gender refers to the socially defined differences between men and women, which are based on widely shared norms within the society (West & Zimmerman, 1987). These differences often constitute barriers to communication depending upon the weight and direction of stereotype that is prevalent in particular societies (Verberder, 1996). Gender study has become a very topical issue globally especially in the social sciences given the palpable and pervasive nature of gender controversy at all strata; thus, its evolution as an integrated part of academic research for many decades either as the primary focus of the study (predictor variable), or as one of many control variables (Gallivan & Benbunan-Finch, 2008; Fox, 2005; Macintyre & Hunt, 1997; Freiden, 1984). The assumption of the impact of the visible characteristics of the source on message effectiveness is confirmed by Sapsord and Jupp (1996), who observed that, “the respondents will ascribe beliefs and opinions to the interviewer (source) on the basis of visible characteristics such as accent and dress (perceived social class), ethnic origin, or gender” (p. 97), nonetheless, the demographic characteristics of the source in determining message acceptance has received little attention. This, probably, accounts for the lack of a standardized instrument for measuring the impact of perceptions of demographic features of the source on message effectiveness owing to the minimal attention given to the study of demography of source credibility.

In the context of health behaviour, the factors of socio-economic position and gender are rarely integrated for explaining the credibility assigned to the source by message recipient. Equally worrisome is the minimal investigation of perceptions of age characteristics of the source in credibility literature (except for example, Weibel, Wissmath, & Groner, 2008). Similarly, there seems to be a “conspiracy of silence” against maternal mortality; an issue still ravaging most developing countries (Briggs, 2009). Culturally, any mention of death makes some people uncomfortable. This sentiment becomes more pronounced when the issue has to do with maternal mortality. The imagination of a neonate without a mother is creates so much empathy on the audience. The feeling is worse if the audience is in a state of pregnancy or knows a close person in that state. However, refraining from discussing maternal mortality will

simply lead to avoidable death; hence, the need to explore all strategies to gain listenership and message acceptability. One of such strategies, as proposed by this study, is to explore the possibility of an audience accepting a message due to the positive disposition to the demographic characteristics of the source of the message.

Review of Literature and Empirical Studies

Extant literature on source credibility has established a link between the characteristics of the source and the audience's attitude towards the disseminated message; thus, the overarching consequence of source credibility on developmental communication is unequivocal. Several empirical studies have been conducted on the influence of source credibility on communication effectiveness (Koslin, Stoops, & Loh, 1970; Hovland & Weiss, 1952, Dutta-Bergman, 2003; Clow, James, Sisk, S, & Cole, 2011; Nagy, Kacmar, & Harris, 2011). Common attributes of the source that are often explored include: trustworthiness, expertise, competence, attractiveness, dynamism, objectivity, believability, professionalism, attractiveness, authoritativeness and related attributes of the source and have been found to have a high influence on message effectiveness (Pornpitakpan, 2004; Dholakia, 1987; Hovland & Weiss, 1952; Copeland, Gunawan, & Bies-Hernandez, 2011; Nishith, Jayswal, & Jayswal, 2012). A study by Hovland and Weiss (1952) revealed that the weight attached to a source's trustworthiness has a significant impact on how the recipient rates the piece of information or message received. In other words, a source with high credibility often elicits more favorable disposition to an advocacy than a source with low credibility barring the period of "sleeper effect"

Gender refers to the socially defined differences between men and women, which are based on widely shared norms within the particular society (West & Zimmerman, 1987). These differences often constitute barriers to communication depending upon the weight and direction of the stereotype that is prevalent in a particular society (Verberder, 1996). In his discussion of masculinity and femininity of cultural dimensions, Hofstede (2002) observed that men are adjudged to be assertive, ambitious, and tough while women are expected to be subservient, tender and attractive. He stressed that "attractive women can use their beauty as weapons in social competition" (p. 101), thus acknowledging the controversial strength of the gender of the source (male and female) in eliciting desired change in behaviour from message receivers. In the same vein, Wood (1994) said that

men and women communicate for different reasons while women communicate to establish and maintain relationship with others, men communicate to exert control, preserve independence, and enhance status. In a review of multi-disciplinary articles on gender studies in Cuba from 1974 to 2001, Sarmiento (2003) revealed a rich understanding of the interplay between the sexes in the society. She concluded that it is impossible to study any matter concerning social behaviour without examining it from a gender perspective.

The significance attached to the concept of age has been well documented in literature. Like gender, the concept of age is relative across culture. In a typical power distance culture, (Hofstede, 2002), elders enjoy unreserved respect and pride of place in all endeavours. This view can be juxtaposed with the findings of Krueger, Rogers, Hummer, LeClere, and Huie (2003) that age determines earning potentials: great potentials for the young and diminishing potentials for the old. Abdelmagid (1990) reported an inconsistent role of age in moderating human judgement. While age interacted significantly in the Policy-Self and Self-Others indices, it failed to interact either as the main effect or in a moderating capacity with the Self-Others index. But in the context of communication, especially in North-Central Nigeria, age is a factor to contend with in public discourse as experience is believed to be a by-product of age.

Mueller and Parcel (1981) have defined the concept of socio-economic status (SES) as the relative standing of a family or individual on a hierarchical social structure, in relationship to their access to or control over wealth, prestige and power. These characteristics can pass for source credibility measures based on their ability to attract believability to whatever their possessor says. Following the arguments for and against the various measures of socio-economic status (SES), and although some researchers have undertaken studies of gender and age as measures of socio-economic status (Aiyedun, 2003; Dwidevi & Lal, 2003; Vereecken, Inchley, Subramaniam, Hublet, & Maes, 2005), Finch (1986) and Morgan (1986) have validated their status as predictor variables. Therefore, the current measurement considers education, professionalism, cultural leaning and marital status as more pertinent measures of the influence of SES as the source for the effective dissemination of information on maternal mortality. Professionalism is preferred to occupation due to its favourable consideration in a naturalistic setting (Greenhalgh, Robert, Mcfarlane, Bate, & Kyriakidou, 2004).

Theory of Source Credibility

Source credibility refers to a set of attributes or characteristics of a source that influences how the receiver or the audience responds towards his message. It can also be seen as an assessment of a set of physical and demographic attributes of the source that influences how the receiver responds or behaves towards the message. The concept enjoys a universal appeal as old as recorded history (Baran & Davis, 2003). The study is rooted in the theories of attitude change in social psychology (Pornpitakpan, 2004) but its reference can be traced to “the Aristotelian dictum that the source’s character may almost be called the most effective means of persuasion he possesses” (Pearson, 1980). However, early empirical study of the concept has been credited to Hovland and his colleagues at Yale University (Baran & Davis, 2003). In an experimental evaluation of the effectiveness of various programmes of the information and education division of the American army during World War II, Hovland and his team used films as stimulus (source) and receivers as subjects while systematically controlling other external variables in order to measure the source’ (films) effectiveness in influencing attitudes and motivation. The outcome of the experiment revealed that, although the movies successfully increased knowledge about the war, they were not as effective in influencing attitude and motivation. The group also discovered that the stimulus only succeeded in strengthening existing attitudes rather than cultivating new ones (Baran & Davis, 2003).

This initial discovery led to a sustained interest in what is now known as source credibility. The group considered the communicator, the content of the message and the audience as central factors in attitude change. In their examination of the communicator, they based source credibility on two factors, trustworthiness and expertise, and concluded that high credibility in communicator was synonymous to an increase in attitude change and vice-versa (Hovland & Weiss, 1951). This model has been adopted in diverse areas of studies that require attitudinal and behavioural changes towards advocated patterns. Principal among these fields are applied psychology, abnormal and social psychology, marketing, advertising, politics, and communication (Koslin, Stoops, & Loh, 1970; Hovland & Weiss, 1951; Dutta-Bergman, 2003; Pornpitakpan, 2004).

The theory of source credibility is often premised on three models: the factor model, the functional model and the constructivist model. However, the factor model appears to be the most employed in social science research. This model determines the extent to which the receiver judges the source as credible based on the assumption of credibility study as a multi-dimensional concept that can be captured fully only by multi-item

measures. Eisend (2006) came up with three main dimensions; sincerity, professionalism and attraction in his examination of source credibility dimensions in marketing communication. Teacher credibility is measured by the dimensions of competence, trustworthiness and caring (Teven & McCroskey, 1997). Consequently, numerous dimensions of source credibility have attracted the interest of researchers. These factors range from similarities between message source and receiver (ethos), media credibility, to plain source credibility as presented in Table 1 below.

Table 1: Some Previous factor model studies of source credibility

No	Author (s)	Concept Specification	No. of Factors	Dimensions
	Hovland and Weiss, (1952)	Communicator credibility	2	Trustworthiness and expertness
	McCroskey, 1966	Source Credibility	2	Authoritativeness and Character
	Umeogu, 2012	Visible elements of Source Credibility	2	Expertise and trustworthiness
	Ohanian, 1990	News Credibility	3	Sincerity, Professionalism, Attraction
	Freiden, 1984	Role of gender in source credibility	3	Gender, Completeness, Accuracy
	Whitehead, 1968	Source Credibility	4	Trustworthiness, competence, Dynamism, Objectivity
	Eisend (2006)	Marketing communication	3	sincerity, professionalism and attraction
	Teven and McCroskey's (1997)	Teacher's competence	3	competence, trustworthiness and caring

There seems to be great acceptance of the assumption that the characteristics of a communicator can impact greatly on the acceptance of the message by the audience (Pearson, 1980; Dholakia, 1987, Umeogu, 2012). This finding prompted the use of testimonials for advertising, endorsers for political aspirants, developmental campaigns and advocacies. Although the consequence of diverse attributes of the source on message effectiveness has been established, these attitudinal qualities require some level of intimacy or interaction between the source and the receiver to decipher. Similarly, this model has been criticised for the likelihood of creating artificial and unstable

factors (Meyer 1988; Schweitzer 1966). Hence, the need to assess the interactive influence of gender, age, and socio-economic status of the source on effective message dissemination and as rightly noted by Macintyre and Hunt (1997) the interactions between these variables are worth examining because they “structure opportunities and life chances” (Macintyre & Hunt, 1997, p. 329).

Method

The study conducted a survey to test the performance of the generated items to measure the credibility ascribed the gender, age and socio-economic status of the source by message recipient in determining message effectiveness from extant literature. The tested and validated items were then administered on selected samples through a survey.

Population of Study

The target population for this study was men and women of child-bearing age in Kwara State (15 and 65 years of age). Age 15 is the National Population Commission’s acknowledged start of reproduction age for females, while age 65 is the age of retirement from Nigeria public service.

Sampling Procedure

A sample of 380 respondents was selected for inclusion in this study through a systematic sampling procedure. According to Sekaran (2003), a systematic sampling procedure can be adopted where a list of entire members of the population can be generated from which a predetermined n^{th} number would be selected for inclusion. Individual participants were selected through simple random sampling from enumerated households. Depending upon the number of people of 15 to 65 years in each household, a maximum of two respondents was selected for inclusion from each household. Where there were more than two eligible respondents from a particular household, Fish and bowl technique, yes/no were written on small wraps of paper and presented to the prospective respondents to pick. Whoever picked ‘yes’ was included in the quantitative data gathering process (Baxter & Babbie, 2001; Baxter, 2004). The questionnaire was administered personally by the researcher with the aid of five well trained research assistants. The validity of the instrument was confirmed via exploratory and confirmatory factor analysis (EFA and CFA).

Item Generation

Items were developed from reviewed literature to measure the influence of gender, age, and socio-economic status on effective dissemination of health information (Hair, Black, Babin et al., 2010). The questions were framed carefully to elicit responses that provided answers to the research questions and aid measurement of the relationship between the identified variables. Responses to the questions were in close-ended forms for ease of analysis. However, provision was made for some brief expressions where necessary. Afterwards, the instrument was given to 10 experts for validity and reliability test, before the self-administered questionnaire was subjected to a pilot study to ensure proper interpretation of instructions and questions by the respondents (Baxter & Babbie, 2004; Creswell, 2007). Initially, a total number of 50 items were developed for the three exogenous variables; twenty-three items were designed to measure the influence of gender of the source; 13 items to measure the influence of age of the source; and lastly 14 items to measure the influence of socio-economic status of the source as presented in Table 2. However, only 20 items withstood the test of time after the rigours of the initial validity tests.

Table 2: *Description of initial items and their sources*

Constructs	Sources	No. of items	Brief description
Gender of the Source	Smith (2008); Duggan and Banwell (2004); Orewere (1991); Feldman-Summers et al. (1980); Bochner, (1994); Pearson, C.J (1980); Ogwurike (2005)	23	Audiences' perception of the impact of the gender of the source, on effective information dissemination.
Age of the Source	Dwivedi and Lal (2007); Lin and Burt (1975); Engstrom (1996)	13	The impact of young or older sources on message credibility.
Socio-Economic Status of the Source	Aiyedun (2003); Krueger, Rogers et al (2003); Imoh (2008); Ogwurike (2005); Orewere (1991); Lin and Burt (1975); Duggan and Banwell (2004);	14	The degree to which socio-economic status such as education, marital status, professionalism, and cultural relevance of the source influence message acceptability.

Rating Scales for the Responses

In line with conventional practice in source credibility studies (Eisend, 2006), a Semantic Differential Scale with bipolar adjectives was employed to describe the respondents' attitude towards particular issues raised in the items. The respondents were instructed to choose from a five-point response scale in which the minimum score was 1 (Very Much Unlike Me) and the maximum score was 5 (Very Much Like Me). Scholars have argued that a five-point scale is as reliable as any other rating (Sekaran, 2010). Neuman (2006) argued in support of having non-attitude and middle position or no opinion responses; moreover, the use of an interval scale like a Semantic Differential Scale establishes the equality of the magnitude of differences between one point on the scale and the next thus giving more meaning to the response choices by the respondents.

Results

The test for multicollinearity is conducted by assigning the role of dependent variable to each of the independent variables in turn to assess the amount of the variance in the selected variable that is unexplained by the remaining independent variables (Hair, Black, Babin et al., 2010). Going by this and the suggested minimal acceptable tolerance value (.10), this study can be said to be free of multicollinearity with tolerance vs VIF values of 0.648 vs 1.543 for GSC; 0.601 vs 1.664 for ASC; and 0.509 vs 1.964 for SESC variables as presented in Table 3.

Table 3: Test for Multicollinearity

Dependent variable		Independent variable	Collinearity Statistics	
			Tolerance	VIF
Gender of the Source		Age of the Source	.648	1.543
		Socio-economic Status of the Source	.648	1.543
Age of the Source		Socio-economic status of the source	.601	1.664
		Gender of the source	.601	1.664
Socio-economic Status of the Source		Gender of the Source	.509	1.964
		Age of the Source	.509	1.964

Exploratory Factor Analysis (EFA)

In line with the convention of available literature on Structural Equation Modeling (SEM), Hair, Black, Babin et al. (2010) and Bryne (2010) suggested a two-step model

building method. The first step involves performing confirmatory factor analysis (CFA) to estimate the overall fitness of the measurement model in testing the relationship among constructs as well as to define the nature of each construct whether reflective or formative. The second is, using the covariance matrix resulting from the CFA from the measurement model, to test the hypothesized relationships between the constructs in the structural model (Hair, Black, Babin et al., 2010). However, prior to conducting confirmatory factor analysis, an exploratory factor analysis (EFA) was performed to purify and validate the untested self-designed measurement scales as suggested by Bryne (2010) and Hair, Black, Babin et al. (2010).

Literature has underscored the need for EFA to identify, summarize and assist in validating factors that contribute differentially to the causal explanation of variance in effective dissemination of information on maternal mortality (Hair, Black, Babin et al., 2010). Following this suggestion, this study used SPSS version 14.0 for Windows to perform the EFA. Here, data was allowed to statistically load on factors that were independent of theory or any a priori assumptions related to the measurement instrument (Hair, Black, Babin et al., 2010). Rules guiding the performance of factor analysis assert that data must meet certain underlying assumptions among which is sample size. The sample size of 375 after deleting the five cases that constituted outliers was adequate for the performance of EFA (Cochran, 1977). The Measure of Sampling Adequacy (MSA), otherwise known as Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy, has been theoretically argued to vary between 0 and 1 (Pinsonneault & Kraemer, 1993). A MSA value that is closer to 0 indicates an existence of higher partial correlation between the variables thus rendering the application of factor analysis to such data inappropriate. Whereas, a value closer to 1 is an indication that the patterns of the correlation are compact, or as Hair, Black, Babin et al. (2010) succinctly put it "reaching 1 when each variable is perfectly predicted without error by the other variables" (p.104). Consequently, the application of factor analysis to such data is expected to yield distinct and reliable factors (Hair, Black, Babin et al., 2010; Pinsonneault & Kraemer, 1993). To play it safe, Hair, Black, Babin et al. (2010) suggested that KMO / MSA values must exceed 0.50 to be deemed fit for factor analysis, otherwise, the researcher would either need to collect more data and/or include more variables. To appreciate the strength of the measure, Hair, Black, Babin et al. (2010) classified any value of 0.80 and above as meritorious; 0.70 and above as middling; 0.60

and above as mediocre; 0.50 and above as miserable; while value below 0.50 were considered unacceptable. The KMO for the data in this study is 0.901, which empirically falls within the category of data that are classified as meritorious. This establishes the appropriateness of factor analysis to the data gathered for this study with some degree of confidence.

The Bartlett test of sphericity, a statistical measure for the presence of correlation among variables, is another prerequisite for the performance of factor analysis (Hair, Black, Babin et al., 2010). Importantly, it is argued that for any factor analysis to be efficient, the researcher needs to establish that the correlation matrix has significant relationships among some of the variables of interest. Bartlett, Kotrlik, and Higin (2001) affirm that, for any Bartlett's test to be significant, it must obtain a statistical significance with value less than 0.05. The output of Bartlett's test in this study: ($\chi^2 = 8069.102$; $DF = 1431$; $sig. = .000$) confirms the existence of some relationships between the perceptions of gender of the source, the age of the source, and the socio-economic status of the source, that have been included in this study for further analysis. This implies that the data in this study is significant at $p < 0.001$.

Having conformed with the stated rules of thumb for performing factor analysis, a Principal Component Analysis (PCA) with Varimax Rotation was performed on the variables: perceptions of gender, age, and socio-economic status of the source. Applying the latent root criterion, only the factors that accounted for the variance of at least a single variable were considered for retention (Hair, Black, Babin et al., 2010). The 50 items that represented all the constructs were factor analysed with unspecified eigenvalue, this resulted in the extraction of six factors with an eigenvalue greater than 1, accounting for 48% of the total variance extracted; an acceptable solution value in the social sciences (Hair, Black, Babin et al., 2010); meaning that, the three distinct factors reflecting the three categories of constructs being studied were all significant. Notably, the first few factors usually explain a larger percentage of variances that are recorded in a study (Hair, Black, Babin et al., 2010). For instance, factor 1 explains about 32 % of the total variance in the analysed data set in this study. The results of the eigenvalues extracted and the percentage of variance explained are presented in Table 4.

Table 4 : Eigen value extracted and total variance explained for the constructs

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.353	31.970	31.970	7.353	31.970	31.970
2	2.076	9.025	40.995	2.076	9.025	40.995
3	1.750	7.609	48.604	1.750	7.609	48.604

Note: Extraction Method: Principal Component Analysis.

As explained earlier, a critical look at the unrestricted EFA showed that a few items fell short of the recommended 0.50 cut-off criterion and that there were a few crossloaded items that can cause confusion in interpretation (g1 and ses3). However, the low loading and the crossloaded were considered for deletion at the confirmatory factor analysis level (Hair, Black, Babin et al., 2010; Tabachnick, 1996; Pallant, 2003). The itemized results indicate that gender of the source variable was measured by seven items after the deletion of two items with less than a 1.0 standard deviation, age of the source was measured by seven items after the deletion of one item with less than a 1.0 standard deviation, and socio-economic status of the source was measured by six items, all totaling 20 items to represent the exogenous constructs. It is worthy of mention that a subsequent analysis through CFA indicated that the average variance extracted in the constructs ranged from 0.75 to 0.88; values that are all greater than the 0.50 cut off criterion as suggested by Nunnally and Berstein (1994). Cronbach's α were also greater than the 0.70 lower bench mark that is specified for exploratory factor analysis (Hair, Black, Babin et al., 2010). Table 5 present the complete list of items that were entered for each construct after the deletion of the three items owing to their lack of variability.

Table 5: Factor Analysis Results and Cronbach's alpha for Gender, Age, and Socio-Economic Status of the Source

Code	Items	Loading			Cronbach's α
		1	2	3	
G1	I accept the content of a message if the source is of the same gender as me.	0.677			0.848
G2	I am more willing to seek further information on a given message if the source is of the same gender as me.	0.637			
G5	I seek further clarification on a given message from others if the initial information was from a male	0.478			

	source.			
G9	I am more willing to listen to a female source of information because of her fluency.	0.578		
A2	I accept information from elderly sources only.	0.550	0.800	
A3	I believe a young source is more innovative in delivering messages.	0.361		
A4	I am willing to adopt messages from a source that is within my age group.	0.540		
A5	I believe a source of information becomes less effective as the person grows older.	0.513		
A6	I will not pay attention to any information if delivered by a young person.	0.643		
A7	I believe a young person does not have adequate knowledge to deliver a message	0.744		
A8	I believe the elders are too emotional to deliver messages effectively	0.522		
SES1	I believe a highly educated source of information only addresses the rich	0.551	0.801	
SES2	I will believe a message if the source is culturally relevant to me	0.559		
SES3	I believe the profession of the source plays a role on his/her style of information delivery.	0.338		
SES4	I am better informed if the source is a specialist on the issue of discussion.	0.694		
SES5	I will adopt the content of a given message if the source is a high-profile figure.	0.721		
SES6	I will cross check any information from unmarried sources.	0.731		

Structural Equation Modelling

The proposed model for this study was tested through structural equation modeling (SEM). Bryne (2010) explains three cardinal strengths of SEM over other forms of multivariate analysis like regression, ANOVA, etc. These are: 1) its ability to simultaneously estimate two structures: the measurement model and the structural model in a single structure; 2) its ability to assess and estimate measurement errors in the explanatory variables that can lead to untold inaccuracies, and lastly, 3) the application of SEM incorporates both unobserved (latent) and observed variables as against other forms of multivariate analyses that are based on observed variables only. The relevance of SEM to the current study is underscored by Shook, Ketchen, Hult, and

Kacmar, (2004), who noted that the application of SEM becomes handy when “strong theoretical underpinnings are critical to causality inferences” (p. 398) in nonexperimental research.

The measurement model indicates how measured variables or indicators come together to represent their unique constructs while the structural model shows the interrelationship between the constructs (Hair, Black, Babin et al., 2010). The first stage involved the confirmatory factor analysis (CFA) to estimate the overall fit of the measurement model among the constructs (characteristics of the source’s gender, age, socio-economic status). The general specifications for a simple measurement model that: 1) each measurement indicator is congenial. i.e., has non-zero loading on the construct it measures but a zero loading on other constructs; 2) the error terms are independent of each other and the factor; 3) associations between the indicators are not measured; and 4) one of the loading paths that are hypothesized to measure a construct must be constrained to have a value of 1.00 for the purpose of model identification are applied here (Hair, Black, Babin et al., 2010; Bryne, 2010; Kline, 2005). This involves an examination of parameter estimates and goodness of fit (Bryne, 2010) through the maximum likelihood procedure. Importantly, all the hypothesized measures for the constructs are reflective.

Confirmatory Factor Analysis (CFA)

The hypothesis to be tested here relates to the pattern of causal structure linking the constructs of perceptions of characteristics of a source’s gender, age and socio-economic status of the source and their consequence on the construct of effective information dissemination. To perform the CFA, all the constructs with their indicators must interact to test their fitness to the model (Hair, Black, Babin et al., 2010). Unlike the EFA, CFA in SEM pre-specified indicators are attached to constructs in a bid to validate the model (Bryne, 2010; Hair, Black, Babin et al., 2010). Through CFA, the strength of each indicator on its latent construct is examined based on factor loadings. Bryne (2010) explained that the factor loading of each measure indicates the correlation coefficient between it and its latent construct. Consequently, in order to establish the validity and the reliability of the measurement model, this study conducted CFA on the individual constructs that constitute the exogenous variables. However, Hair, Black, Babin et al. (2010) cautioned that the determination of the performance of an item

should not rest solely on significant loading alone, rather, consideration should also be given to the statistical significance of each estimated coefficient. Although all the loadings are significant at $p = .001$, the items that are observed to be of lower values are subjects for deletion (Bryne, 2010; Hair, Black, Babin et al., 2010). The CFA loading depicts the standardized maximum loading estimate for the 20 indicators representing perceptions of characteristics of gender, age, socio-economic status of the source — the exogenous constructs.

Construct Reliability and Validity

Construct validity was evaluated by assessing the item loadings, their corresponding t -values, composite reliabilities, as well as average variance extracted. A critical view of the results in Table 6 reveals that a larger percentage of the proposed indicators of the constructs of interest to this study have factor loadings above 0.50 indicating that the hypothesized items truly have strong relationship with the conceptualized model, an evidence of convergent validity (Hair, Black, Babin et al., 2010). Their significant critical ratios (t -value > 1.96 , $p < 0.001$) are also indicative of their differences on the constructs they are purported to measure; if otherwise, Anderson & Gerbing (1988) suggested that such indicator should be eliminated. Table 11 presents all 20 items of the exogenous constructs with loadings ranging from 0.438 to 0.724 before modification. Of equal importance to SEM is the calculation of composite reliability to demonstrate the reliability of the factors and the internal consistency of the items. The established composite reliability indicates a strong internal consistency between the indicators in the model as well as a correlation between all the constructs in the model. This leads to a conclusion that the data in this model have both construct and convergent validity as the estimates of most of them are > 0.5 minimum criterion (Hair, Black, Babin et al., 2010). The composite reliability values are in the range of 0.806 to 0.88; exceeding the 0.70 minimum criterion Fornell and Larcker set (1981).

Table 6: *Summary of item analysis*

Constructs	Code	Factor Loading	t-value	Composite Reliability
Gender of the Source	G1	.629	12.045***	0.880
	G2	.587	12.383***	
	G3	.597	12.348***	
	G4	.674	11.654***	
	G5	.616	12.237***	
	G6	.687	11.589***	
	G9	.576	12.515***	
Age of the Source	A2	.529	12.718***	0.820
	A3	.496	12.895***	
	A4	.673	11.637***	
	A5	.674	11.652***	
	A6	.631	12.002***	
	A7	.464	12.982***	
	A8	.650	11.903***	
SES of the Source	SES1	.656	11.664***	0.806
	SES2	.689	11.167***	
	SES3	.509	12.750***	
	SES4	.566	12.459***	
	SES5	.724	10.606***	
	SES6	.684	11.156***	

Note: *** p < .001.

Discriminant Validity

To pass the test of discriminant validity, the average variance extracted for any two constructs that are measured must be greater than the square of correlations that exist between them (Fornell & Larcker, 1981). Discriminant validity also confirms that individual measurement indicators only represent one latent construct without cross loading. Table 7 presents the summary of the calculated variance extracted (VE) based on the squared multiple correlation (SMC) and the standardized error of variance (SE). The Average Variance Extracted (AVE) in this study ranged from 0.58 to 0.73, thus exceeding the minimum 0.5 criterion (Barclay, Thompson & Higgins, 1995). This implies that the variance of the measurement error is less than the variance that the latent construct captured.

Table 7: Test of Discriminant Validity

Construct	1	2	3
Age of the Source	0.68***		
1. Socio-Economic Status of the Source		0.58***	
2. Gender of the Source			0.73***

***p < 0.001.

Testing Individual Construct Measurement Model

In order to establish convergent validity of measured variables on the construct they are proposed to represent, we conducted single-group measurement analyses (Bryne, 2010; Hair, Black, Babin et al. (2010). The CFA tests were based on multiple goodness-of-fit indices to affirm the strength of the models (Breckler, 1990; Anderson & Gerbing, 1992).

Perceived Gender of the Source Credibility Measures

The hypothesized model for the gender of the source variable had all seven indicators entered as shown in **Table 8**. Although this result was fairly fit, the required ratio of < 0.2 was not achieved; the RMSEA was also higher than the acceptable < 0.05 value. Consequently, model was trimmed to achieve acceptable goodness of fit indices was. Item g1 was deleted based on its high modification indices and cross loading on other indicators.

Table 8: Measurement Model for Perceived Gender of the Source Construct

	X ²	DF	Ratio	Pvalue	GFI	AGFI	CFI	TLI	RMSEA
First Model	61.26	14	4.378	.000	.953	.907	.933	.900	.095
Trimmed model^a	17.12	9	1.903	.0.04	.986	.967	.985	.975	.049

Note: Fit model was achieved for the gender of the source variable after the deletion of one item owing to high modification indices and cross loading.

Perceived Age of the Source Measures

Although the seven items hypothesized for the age of the source model fairly met the criterion for the measurement of goodness of fit indices, the ratio was greater than the

cut-off less than 2 values. Hence, item a2 was deleted at this individual measurement test level on the basis of cross loading on the modification index. A summary of the fitting process is presented in Table 9.

Table 9: *Measurement Model for Perceived Age of the Source Construct Model*

	X ²	DF	Ratio	Pvalue	GFI	AGFI	CFI	TLI	RMSEA
Hypothesized Model	34.10	14	2.436	.002	.975	.951	.965	.948	.062
Trimmed model^a	15.67	9	1.741	.074	.986	.968	.986	.976	.044

Note: The fit model for the perceived age of the source data was achieved after the deletion of item a2.

Perceived Socio-economic status of the source measures

Six items were hypothesised to represent the socio-economic status of the source construct. The CFA measurement test yielded just fair results. Although the GFI had a value greater than 0.9, the AGFI, CFI, and TLI were less than the minimum cut-off criterion. The ratio was also greater than 2, and the RMSEA is greater than the cut off 0.05 criterions (Bryne, 2010; Hair, Black, Babin et al., 2010). Hence, the need existed for modification to achieve the acceptable goodness of fit indices. In pursuing an acceptable fit model, items SES1 and SES2, which were observed to have higher modification indices, were deleted. The outcome is presented in Table 10.

Table 10: *Measurement Model for Perceived Socio-Economic Status of the Source Model*

	X ²	DF	Ratio	Pvalue	GFI	AGFI	CFI	TLI	RMSEA
Hypothesized Model	82.33	9	9.149	.000	.930	.837	.889	.815	.147
Trimmed model ^a	3.060	2	1.530	.216	.996	.980	.997	.991	.038

Note a: Fit model is achieved after the deletion of SES1 and SES2.

MEASUREMENT MODEL FOR THE EXOGENOUS CONSTRUCT

Having established the convergent validity of the measures on the individual exogenous constructs at the preliminary single-group analyses, perceptions of the three

demographic variables of the source (gender, age and socio-economic status constructs) were caused to interact in a single composite measurement model as suggested by Hair, Black, Babin et al. (2010) so as to gauge their causal relationships on the endogenous construct. A correlation was run to examine the relationships between them as well as to establish their differences. Table 11 shows that the correlation between the three constructs ranges between 0.582 and 0.768, which are adequate correlation parameters and all item covariance are significantly different (t -value > 1.96).

Table 11: *Correlations among Exogenous Constructs*

Covariances	Estimates	S. E.	C. R. (t -value)	Correlations
GSC <--> ASC	.229	.034	6.667***	.768
GSC<--> SESC	.222	.043	5.202***	.582
ASC<--> SESC	.269	.046	5.819***	.710

Note: *** $p < 0.001$.

Of the 20 items that were hypothesized in the study as measuring the influence of the perceived characteristics of gender, age and socio-economic status of the source on effective dissemination of information on maternal mortality, only 16 were statistically reliable and fit the final measurement model. Figure 1 below reveals that the relative chi-square (χ^2/df) for the data is 1.942, the GFI= .940, the AGFI= .919, the CFI = .946, the TLI = .936 while the RMSEA = .050 demonstrating that the indicators on the three constructs fit the model. Although the model did not meet the 0.95 cut-off criterion for the absolute and incremental indices (Bryne, 2010, Hair, Black, Babin et al. 2010; Hu & Bentler, 1999), it satisfied the minimum requirement of 0.90 albeit with a significant p -value

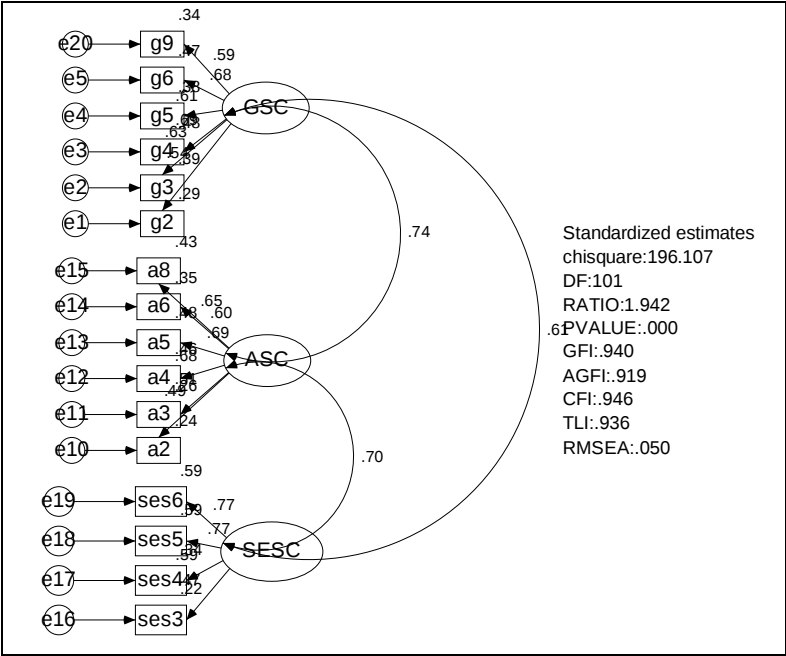


Figure 1: Measurement model for the exogenous constructs.

Discussion of Findings

Since the original contributions to source credibility studies by Hovland, Janis, & Kelly, 1953; Berscheid, 1966; Chaiken, 1979; Johnson, Torcivia, & Patrick, 1968; McGinnies & Ward; 1980; Mills & Harvey, 1972; Ross 1973; Wu & Shaffer 1987 in communication; Applbaum & Anatol, 1972; Berlo, Lernet, & Mertz, 1969; McCroskey, 1966; Miller & Basehart, 1969; Whitehead, 1968 in marketing and Baker & Churchill, 1977; Caballero & Solomon, 1984; DeSarbo & Harshman, 1985; Kahle & Homer 1985; Mowen & Brown, (1981) in advertising, source credibility has been operationalized variously by means of a reliable and valid measurement . However, the experimental studies that have been used for various dimensions of source credibility have not been consistent in their manipulation checks of the experimental variables. The current research has defined the domain of the source credibility construct and has developed a reliable and valid scale for its measurement. The following 16 items in Table 12 were found fit to examine the impact of the demographic features of the source on his or her credibility:

Table 12: *Items Found Fit to Examine the Impact of the Demographic Features of The source on His or Her Credibility*

S/N	Item
1	I am more willing to seek further information on a given message if the source is of the same gender as me.
2	I easily remember a given message if it is from a female source.
3	I discuss any information from a female source with my spouse before taking decision.
4	I seek further clarification on a given message from others if the initial information was from a male source.
5	I can identify myself in a message if it is from a female source.
6	I am more willing to listen to a female source of information because of her fluency.
7	I accept information from elderly sources only.
8	I believe a young source is more innovative in delivering messages.
9	I am willing to adopt messages from a source that is within my age group.

-
- | | |
|----|---|
| 10 | I believe a source of information becomes less effective as the person grows older. |
| 11 | I will not pay attention to any information if delivered by a young person. |
| 12 | I believe the elders are too emotional to deliver messages effectively. |
| 13 | I believe the profession of the source plays a role on his/her style of information delivery. |
| 14 | I am better informed if the source is a specialist on the issue of discussion. |
| 15 | I will adopt the content of a given message if the source is a high-profile figure. |
| 16 | I will cross check any information from unmarried sources. |
-

The measurement consists of three constructs based on perceptions toward: 1) gender, 2) age, and 3) socio- economic status of source credibility in effective information dissemination regarding maternal mortality. From a theoretical perspective, by identifying and measuring this tri-component construct, the researcher can validly assess the impact of each dimensions of the source credibility scale on maternal mortality information or any information geared towards attitudinal or behavioural change.

The findings of this research have supported the views of previous scholars that the effectiveness of disseminated information depends largely on the credibility of the source. In specific terms, the findings have lent credence to the findings of Sarmiento (2003) who said that asymmetries in perceptions of the gender of the source would impact the credibility of message delivered.

The findings of this study are also consistent with literature that has shown that some characteristics of the message recipient do bear some consequences on the extent to which perceptions of age of the source determine message effectiveness. Borrowing from Krueger, Rogers et al (2003) age determines earning potentials: great potentials for the young ones and diminishing potentials for the old. Just as Salman and Hashim (2011) report a generational difference between the younger and older Malays in the ranking of mass media outlets for information sourcing and internet usage. Dwivedi and Lal (2007) contended that elders needed to be trained to get maximum benefit from information technology. This can further inform their roles as information sources and recipients.

Different communication processes and channels reach different age groups depending on the social, economic, political and geographical context. The socio-economic status of the source plays small role in determining the success or otherwise of the disseminated message.

Conclusion

This article provides a basis for the identified potentially relevant associations between the demography of the source and information dissemination outcome. It is expected that if message recipients are convinced of this important association, they will be more attentive and responsive to the communicating-to-induce change process. Of the initial 50 items that were drawn from the pool of literature to examine the impact of the perceptions the gender, age and socio-economic status of the source on message effectiveness, 16 items strongly emerged as fit for measuring the constructs.

Recommendations

The consistent use of the same instrument can illuminate the comparison of findings across several studies and can contribute to source-scale credibility literature. Thus, the present scale can be adapted to a variety of situations. Researchers in political science can use the scale to investigate the credibility of a political candidate. In political campaigns, a candidate's success depends upon his/her ability to acquire the voter's trust, approval, and confidence in his/her knowledge and ability from demographic perspective. In instructional settings, the scale can be used to evaluate the influence of the instructor's characteristics on student's evaluations of the teacher. The generated instrument has increased the array of measuring items that are available for source credibility studies. The acceptable validity and reliability values of the instrument strengthen their replication in other studies and other context.

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INVESTIGATING THE EFFECT OF DATA NORMALIZATION ON PREDICTIVE MODELS

Ajiboye, Adeleke Raheem

Department of Computer Science,
University of Ilorin,
Ilorin, Nigeria
ajibraheem@live.com

Ajiboye, Ismail Kolawole

Department of Computer Science
Abdul-Raheem College of Advanced Studies
Igbaja, Nigeria.
fabik2000@gmail.com

Salihu, Shakirat Aderonke

Department of Computer Science
University of Ilorin
Ilorin, Nigeria.
shaksoft@yahoo.com

Rasheed Adekola Tomori

Computer Services & Information Technology
University of Ilorin
Ilorin, Nigeria
tomorirasheed@yahoo.com

Abstract:

The creation of predictive model using a supervised learning approach involves the task of building a model of the target variable as a function of the explanatory variables. Before a model is created, it is necessary to put the data in a suitable format. Studies have shown that normalization of data is crucial to descriptive mining as it improves the accuracy and efficiency of mining algorithms. However, in the case of prediction, it is not in all cases that predictive models are created from normalized data. This paper presents the experimental results of investigating the effect of normalizing the input variables on models created for prediction purposes. Experiments are conducted for the creation of predictive models from two different sets of equal size of data using neural network techniques. The trained network models created with the same architecture and configurations are subsequently simulated using a set of untrained data. The evaluation results and the comparison of the models created through the two data sets of different format reveals that, the model created from a normalized data appears to be more accurate as a decrease in error by 0.003 are consistently recorded. The model also converges much earlier than the model created from the data that does not undergo any form of normalization.

Keywords: data normalization, data pre-processing, predictive model, supervised learning.

Introduction

Normalization of data is one of the pre-processing tasks that are sometimes performed on the data to be trained. But in some cases, a number of training algorithms accept numeric data for training despite such dataset might not have been normalized. This calls for an investigation of data normalization effects on the creation of predictive models proposed in this study. The normalization in this context is in relation to transformation of data for training purposes. Several data normalization techniques are reported in the (Han et al., 2012; Quackenbush, 2002), however, these methods share similar motive of reducing the size of the data through scaling. This makes the data to

fall within a smaller range, such as -1.0 to 1.0, or 0.0 to 1.0. Some of the commonly used normalization strategies are: min-max, decimal scaling and z-score normalization.

Using a particular normalization method is a matter of preference, most importantly; the technique of choice must be applied to the whole data sets to be trained for uniformity sake. A number of literature such as (Han et al., 2012), has shown that in descriptive mining, it is necessary to have data normalized especially when a distance-based method is to be used. A typical example of descriptive mining is Clustering. This study therefore, experiments on a number of predictive attributes in order to establish whether the same rule extends to predictive mining.

The predictive and descriptive tasks have been identified in (Kumar, 2014) as the two major tasks performed in data mining. Predictive applications of data are somewhat more complex due to the fact that they add to the data some external assumptions about repeatability and fidelity (Hancock, 2012). Building of models from data requires adequate pre-processing in order to put the data in a suitable form for mining purposes. One of the main reasons why normalization of data is crucial to distance-based descriptive method as revealed in (Han et al., 2012) is that, it brings about accuracy and efficiency of mining algorithms.

The models created are based on the numeric data generated for the purpose of this study. The generation of the data conforms to a number of procedures enumerated in Section 4. The result of evaluating each model that is created reveals both the effect of data normalization and the direct use of dataset that has not undergone any form of normalization. This study reveals that, data normalization is related to the number of iterations during the training process and capable of preventing over-fitting. There is over-fitting when the error on the training set is driven to a very small value, but when new data are presented to the model, the error becomes large (Beale et al., 2010). This implies that, the model has learned the trained data, but the learning is not sufficient enough to generalize to new situations.

The focus of this study is to investigate the normalization effect on construction of a predictive model. Experiments carried out in this study use the normalized data and dataset that does not undergo any form of normalization. The rest of this paper is structured as follows: In the next section, pre-processing of data is discussed. In Section 3, the act of building models from data is briefly discussed, while in Section 4, some related works reported in the literature are reviewed and the techniques used for the creation of predictive models are discussed in Section 5. The results are represented in

graphical and tabular forms in Section 6, while the discussion of findings is presented in Section 7. This study is concluded in Section 8.

Data Pre-processing

Dataset can be viewed as a collection of data objects; other names by which data objects is being addressed are: record, point, vector, pattern, event, case, sample, observation or entity (Kumar, 2014). Generally, the first task that should be performed on a data set is to do some simple data quality examination. This first exploratory exercise would reveal the nature of the variation and quality of the data set. This is because, for many real-world application of data mining, most especially when there are huge amounts of data, the subset of cases with complete data may be relatively small.

Preparation of data is the principled conditioning of a data set to preserve and make more accessible its latent information, while reducing the effects of non-informative artifacts (Hancock, 2012). Pre-processing is in the form of natural reformatting and it should be performed on the dataset in order to satisfy the input requirements of data mining tools and systems. In the process of mining of data for knowledge discovery, there are a number of interactive sequences that must be followed. These sequence or steps are listed in (Han et al., 2012) as the data cleaning, data integration, data selection, data transformation, data mining, pattern evaluation and knowledge representation. The task performed in steps 1 through 4 are different forms of data pre-processing used for preparing data in a suitable form for mining purposes.

There are some reasons that may necessitate pre-processing of data prior to mining. One of the reasons might be the need to remove the inconsistencies in the data, as real-world data are susceptible to noisy, missing and other form of inconsistencies. After successful cleaning of data, the focus should be on the need to have the data normalized or applying any form of transformation suitable for the task at hand. The cleaning of the data and transformation techniques such as discretization and normalization of data are generally referred to as data pre-processing. The task that is performed at this stage usually consumes the largest portion of the total data engineering effort.

Normalization of data takes different forms, sometimes, the data values are scaled to a specific range, for instance, $[-1,1]$, or $[0,1]$. There are many other ways of normalizing data, some of the effective normalization techniques are listed in (Kantardzic, 2011) as decimal scaling, min-max and standard deviation. In the process of preparing data for the creation of predictive models in this study, the normalization technique used is standard deviation. Detail of the technique is discussed in Section 5.

Model Building from Data

A model can be described as a simple representation of a more complicated system and could be static or dynamic (Wu & Coggeshall, 2012). Predictive model is the task of building a model of the target variable as a function of the explanatory variables. Prediction is described in (Hancock, 2012) as data in action, the observed facts of past experience moving into the present and future. However, prediction is almost and most times based upon correlation: when these data are observed, certain conditions often co-occur.

Predictive model basically involves the creation of model that is capable of predicting the expected results from the predictive attributes (variables). This is mostly achieved through the use of machine learning. The resulting model for prediction should have an acceptable level of accuracy especially when simulated with the sets of untrained data.

Relevant algorithms for prediction can be implemented on a well pre-processed data with a view to creating predictive or descriptive model from such data. During the training process, the algorithm tries to establish relationships between the predictive attributes and the target otherwise referred to as expected outputs. Typical among the techniques that can be used for building models from data include: neural networks, support vector machine, decision tree, k-nearest neighbour, Naive Bayesian etc. Most of the algorithms that create model in these techniques are implemented in several data mining tools such as Weka, Rapidminer, Matlab etc.

Literature Review

The creation of the data mining model is well reported in the literature. The model of concern in this study is a predictive model. Most researchers consider normalization of data as a norm, but in some cases, other pre-processing techniques may be the most suitable since data normalization is just one of the transformation strategies. Although, normalization of data is peculiar to both predictive and descriptive mining, but the rationales for using it for descriptive mining has been made clear in the literature, as the technique usually improves the accuracy and efficiency of mining algorithms involving distance measurements (Han et al., 2012). Their further argument was to avoid assigning too much weight to those features that appears to have larger values. The explorations of data reported in (Aggarwal, 2001; Liu et al., 2006; Strehl et al., 1999) found normalization useful for their studies.

The importance of normalization of input variables is reported in (Sola & Sevilla, 1997), the study applied neural network techniques for complex industrial problems. Normalization of data is a pre-processing task and generally, for effective exploration of data for the creation of a model makes data pre-processing inevitable. For instance, pre-

processing is found to be useful in the creation of models such as for fraud detection (Fast et al., 2007), for human metabolomics studies (Bijlsma et al., 2006), for curve fitting in reverse engineering (Huang & Tai, 2000), and for several other reasons. Essentially, pre-processing aims at putting data in a suitable format for mining or analysis in order to achieve a better results.

Study in (Rinnan et al., 2009) focused on pre-processing techniques for near-infrared spectra. The study asserts that, pre-processing removes physical phenomena in the spectra which bring about significant improvement in multivariate regression, classification model or exploratory analysis.

Classification is a form of prediction and sometimes, data normalization is used in classification problems. For instance, in a twitter sentiment classification reported in (Go et al., 2009), the study applied the concept of normalization on the sentiment data and describes other pre-processing steps needed in order to achieve high accuracy and effective classification.

The reviewed literature that relates to creation of models found normalization useful and as a strategy that is capable of improving the accuracy of a model. However, several studies did not reveal the pre-processing approach used on the data, while some uses normalization and transformation interchangeably. This study therefore, experiments on equal size of normalized data and sets of data that is not normalized with a view to establishing its usage for models created for prediction purposes.

Material and Methods

The technique of neural network is used for the creation of predictive models in this study based on feed-forward architecture. The implementation is done in a Matlab Software environment and in the process, predictive network models are created. The models created from the normalized data forms the bulk of the results in the first phase of the experiment (see the description in Section 5.2.1), while the models created from another set of data that does not undergo any form of normalization forms the bulk of results in the second phase of the experiment (see the description in Section 5.2.2). In order to determine the efficacy of the models created, evaluations are carried out on each model and comparisons are made based on some metrics. The findings from this study are discussed in Section 7.

Data sets

The required data for this study is numeric data that can be trained using the techniques of supervised learning methods. There are a number of ways by which data can be collected for mining purposes and for certain specific task, especially for implementation purposes, the required data can be generated. Some variables in this instance, variables 1, 2, 3 and 4 are taken as predictive attributes. The target data is the expected output. The data sets from which predictive models are created in this study is generated based on the following procedures:

Var1 – This is the first predictive attribute in the relation. The numeric data is in the form $X_1 \dots X_n$, where X_i is the first numeric value and X_n is the last numeric value.

Var2 – This is the second predictive attribute in the relation. The data within this domain conforms to the expression $2(X_1 \dots X_n)$. It doubles the values in var1.

Var3 – The data here forms the third predictive attribute in the relation. The numeric values in this field conform to the expression $3(X_1 \dots X_n)$. This is exactly triple of the first predictive attribute.

Var4 – This is the last predictive attribute. The pattern of the data in this field conform to the expression $4(X_1 \dots X_n)$, which is a product of 4 and the data values contained in the first variable.

Target – This is the expected output. The domain in this field is the mean value of all the four variables that collectively form the input. The numeric data within this domain conforms to $\sum(\text{var1} + \text{var2} + \text{var3} + \text{var4}) / n$, where $\text{var1} \dots \text{var4}$ are the predictive attributes (input) and n is number of predictive attribute under consideration.

In each case, $i \dots n$ are numeric values. A relation that consists of 4000 tuples is eventually generated. In order to fit predictive models from these data sets, experiments are carried out, which requires splitting the data into two equal parts. The detailed experiments which include the training of the data and subsequent simulation of the network models using sets of untrained data are presented in the next sub-section.

Experimentations

The fitting of predictive models from the data sets generated involves using the normalized data for the creation of the first model, while the second model is created without transforming the data with any form of normalization. The process of normalization in this study transforms each numeric data in the input space before the training commences. The normalization of the input data is achieved through the computation of the mean value for each input attribute of the data being explored. The mean value of each input attribute is used to average the whole training data in that field.

This is repeated for each variable in the input space. The computation of mean value is achieved using the formula represented in Eq. (1).

$$\bar{X} = \frac{1}{n} [x_1 + x_2 + \dots + x_n] = \sum_{i=1}^n \frac{x_i}{n}$$

(1)

where $\bar{X}$ = mean, x_i = the values of the input attribute
 $\sum$ = total sum of the values
 n = number of sample cases

Only 2000 of the data sets which forms half of the whole data generated are normalized. The other portion of the data is used directly for the creation of model without undergoing any form of normalization.

Creation of predictive model using normalized data

Neural networks have emerged as advanced data mining tools in cases where other techniques known for data exploration may not produce satisfactory predictive models. The technique of neural network implemented in Matlab Software is used in this study to create a predictive model from the normalized data; this is the first phase of the experiments carried out. The second phase of the experiments creates the predictive model without normalizing the sets of data used. The creation of predictive models in this research uses the concept of early stopping in neural networks for the training of the data sets. The approach divides the available data of size 1600 into three subsets: training, validation and testing in the ratio 60:20:20. The approach is one of the possible ways of improving generalization in neural network. Also, the model creation conforms to the technique of supervised learning, as each input is associated with a specific desired target pattern.

In the course of the experiments, the configuration of the network conforms to the following settings:

Algorithm (*Training*: Levenberg Marquardt) ;

Properties (*Network type*: Feed-forward BP ; *Performance*: Mean Square Error) ;

Parameters (*Epochs*: 1500 ; *Goal*: 0 ; *Validation*: checks 7) ;

Architecture: 4 – 3– 1.

Other parameter settings are left in their usual default. With the use of normalized data, the network is properly trained and it uses the MSE as an objective function. In other to determine the effectiveness of the model created, it is simulated using sets of 400 untrained data. The correctness of the result of simulation is evaluated against the

expected output of the untrained data. The error which is degree of deviation from the expected outputs is determined using the Mean Absolute Error (MAE). This is achieved based on the formula represented in Eq. (2). Among several evaluation measures of numeric prediction, MAE is the preferable measurement in this study because it is the average of the magnitude of the individual errors regardless of their sign and with this error function; all sizes of errors are treated evenly according to their magnitude.

$$\text{MAE} = \frac{|\rho_1 - a_1| + \dots + |\rho_n - a_n|}{n} \quad (2)$$

where ρ_1 is the expected output, a_1 is the predicted output and n is the size of the data from which model is being fitted. After the model is created with the normalized data and evaluated using mean absolute error, a repeat of the experiment shows consistency in the output predicted as the error rate appears to be constant. Therefore, in order to avoid repetition of similar outputs, only a representation is shown in the result section. The creation of another network predictive model using the set of data that does not undergo any form of normalization is discussed in the next section.

Creation of predictive model without normalizing the data

In Section 4.2.1, the experiments carried out focuses on using a normalized data to create a prediction model. By following similar steps discussed in Section 4.2.1, another model is created using equal size of data sets used in the previous experiment but without normalizing the data in the input space. Just like in the previous experiment, the input data are trained against the target output. In both cases, random is the function used for the data division, while Levenberg Marquadt otherwise known as back-propagation algorithm (represented in Figure 1), is the training algorithm applied and the configurations of the networks and other parameter settings are the same in both experiments.

Like in the first experiment, the Mean Square Error (MSE) is the performance function that measures the errors during the training process. As the training progresses, computation of error is done at the end of each epoch; this makes the changes in error to be quickly noticed. The total number of neurons used is 10. Although, neuron normally increases the processing power of the network, however, too much neuron in a network can lead to over-fitting. The error goal is set to zero, because there was no need to make provision for error. In case the network cannot be trained to achieve zero error goals, the maximum fail is set to 7.

The resulting outputs of the two approaches is analysed and represented in Table 1. Specifically, the table compares the epochs of both models during the training process and the degree of deviation of each model when simulated with new set of untrained data and subsequently evaluated using mean absolute error discussed earlier. The back propagation algorithm adapted from (Han et al., 2012), is represented in Figure 1.

The algorithm is basically structured into three parts. The first part is the input section; the data set consist of the training tuples and their associated target values. The second part is the output section which gives the predictive model and the third section describes the procedures involved for the training of the data using the concept of feed-forward technique.

The network weight and biases are first initialized, propagate the input forward, back-propagate the errors and this process continues until the validation begins to notice an increment in error rate. At this point, the training process converges to avoid over-fitting. The algorithm in figure 1 shows detail steps for the entire training process.

Input:

D, a dataset consisting of the training tuples and their associated target values;

L, the learning rate;

Network, a multilayer feed forward network.

Output: A trained network

Method:

1. Initialize all network weights and biases ;
2. **while** terminating condition is not satisfied{
3. **for** each training tuple X in D{
4. // propagate the input forward:
5. **for** each input layer unit j {
6. $O_j = I_j$ // output of an input unit is its actual input value
7. **for** each hidden or output layer unit j {
8. $I_j = \sum_i w_{ij} O_i + \theta_j$; //compute the net input of unit j with respect to the previous layer, i
9. $O_j = \frac{1}{1 + e^{-I_j}}$; } // compute the output of each unit j
10. // Back propagate the errors:
11. **for** each unit j in the output layer
12. $Err_j = O_j (1 - O_j)(T_j - O_j)$; // compute the error
13. **foreach** unit j in the hidden layer,
14. $Err_j = O_j (1 - O_j) \sum_k Err_k w_{jk}$; // compute the error with respect to the next higher layer, k

15. **for** each weight w_{ij} in network {
16. $\Delta w_{ij} = (l) \text{Err}_j O_i$; // weight increment
17. $w_{ij} = w_{ij} + \Delta w_{ij}$; } // weight update
18. **for** each bias θ_j in network {
19. $\Delta \theta_j = (l) \text{Err}_j$; // bias increment
20. $\theta_j = \theta_j + \Delta \theta_j$; } // bias update
21. }}

Fig. 1. Back-propagation algorithm.

Results

This section shows the graphical performance of each predictive model. The training performance of the models are automatically generated to show the trends of the trained data during the training process as represented in Figures 2 and 3. The results as represented in the figures basically show the training patterns of each model. The objective function that determines the errors during the training process is Mean Square Error (MSE). During the simulation process, new set of untrained data is used to evaluate the effectiveness of the models created; the error associated which each model is computed and recorded as shown in Table 1. This is further discussed in the next section.

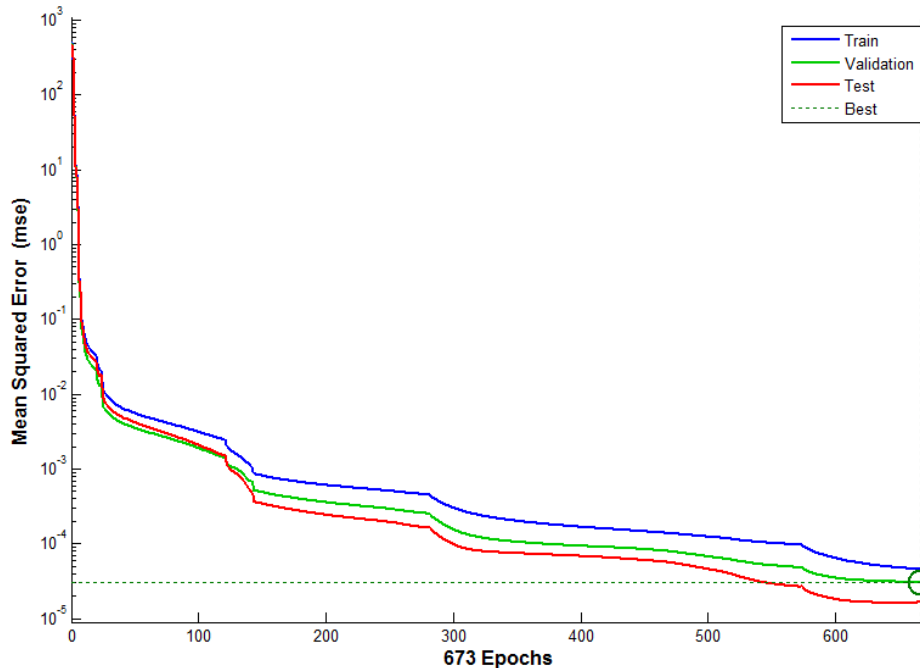


Fig. 2. Training performance of the predictive model created using normalized data for training.

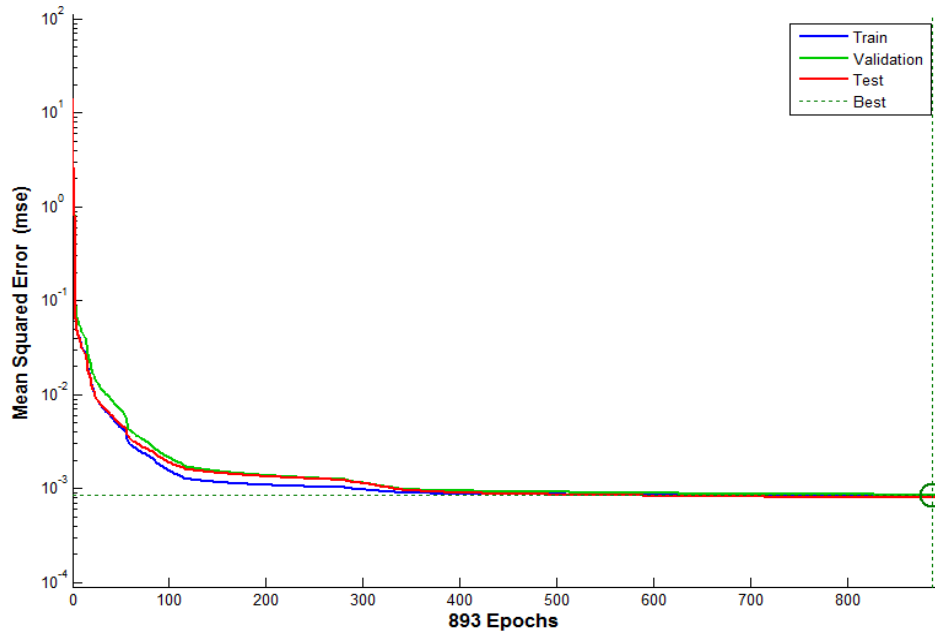


Fig. 3. Training performance of the predictive model created without normalizing the trained data.

Table 1. Comparison of the models created from two different data formats

Dataset	No. of Iteration	Error rate
Creation of predictive model without normalizing the data	893	5.0320
Creation of predictive model using normalized data	673	5.0008

Discussion of Results and Major Findings

The training performance graph, that is automatically generated, plots the objective function against the number of iterations. As shown in Figure 2, the lines that represent training, validation and test data looks perfectly similar. The best validation performance is reached at epoch 673. At this point, the validation data triggers the convergence of the training process. From the point where the training commences, there is a continuous reduction in error up to the time of convergence. Even at the time when the training process converges, there is no clear evidence of increase in error. If an error is low during the training process, it may not necessarily follows that the error

must be low when simulated using the untrained data. It is a different thing entirely at the evaluation stage since no target data is provided during the simulation process. This is why the errors at this stage is not given prominence in Table 1, but can be deduced from the performance graphs.

Also in Figure 3, the plots that represents the training, validation and testing moves at the same pace which shows some significance reduction in error up to the point of convergence. However, the number of iteration (epochs) for the training data continue to increase and this pace is maintained up to the convergence point as shown in Figure 2. Looking at the graphs further, the line that represents the validation and test, exhibit some similarities and at the time of convergence, no sharp increase in error is noticed in the validation data. The results of evaluating the two network predictive models reveals that, normalizing the data for the purpose of creating prediction model has no much impact. The results of this study show that, normalization of data only has very little impact as only 0.031 is recorded as the error difference. However, the effect of normalizing the data in the input space prior to training is seen in the iteration process. While the network whose data is normalized iterates for 673, it takes the un-normalized data more epochs to converge, as it finally converge at epochs 893 (see Figure 3).

It can therefore, be deduced from this research that, normalization of training data for the creation of predictive models is desirable but not mandatory. The experiments conducted have reveals that, impressive results can still be achieved without normalizing the data in the input space. However, normalization has a number of advantages such as early convergence and improvement in the accuracy of the model created.

Conclusions and Future Research

This study experiments on two sets of data of equal size and under the same network architecture for the creation of predictive models. The paper specifically aimed at investigating the effect of normalizing the data sets in the course of creating a predictive model. Due to consistencies experienced in the network models created, a single training performance graph is selected to represent all the models created using normalized data; similarly, only one model is chosen to represent a similar set of models created using data that did not undergo any form of normalization. Evaluation of each model reveals that there is no grievous implication if the data to be trained in the creation of prediction model is not normalized. However, comparison of the results that emanate from each approach shows that, normalization of the data in the input space gives better accurate predictions and converges much earlier.

Studies reported in the literature have shown why normalization of data is inevitable especially for descriptive mining that uses distance-based technique. A number of experiments conducted in this study have been able to unveil the implications of normalizing data in the course of creating model for prediction (predictive mining). In the near future, we hope to extend this work to encompass other sets of data type different from numeric data. Our future research would focus more on exploration of spatial and other non-numeric data.

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ARCHIVAL SYSTEM FOR PROJECTS USING ASSOCIATION APPROACH

Oladele T. O., Ojeh A. and Afolayan I.

Department of Computer Science, University of Ilorin, P. M. B. 1515, Ilorin, Nigeria.
oladele.to@unilorin.edu.ng +234 8164916082

Abstract

This paper is aimed to tackle the limitations and shortcomings of the existing system by developing a data mining software that will store completed projects for easy access for anyone most especially students and Lecturers/Supervisors and also researchers who may benefit from the use of its holdings. In this paper, the use of Dreamweaver integrated development environment which embeds the functionality of PHP and a query language (MYSQL) were employed in the development of the archival system since it is a web platform. Once a search query is entered for a project topic, a search result showing similar or related project topics will be displayed at once. This gives a high hit rate as compared to some search engines. The need for an Online Archival system for project management cannot be over emphasized because of the efficient matter in which it eases the stress of consulting past projects manually. The Archival system is recommended for implementation in the University Library and in all Departments of the various Faculties in the University.

Keywords: Data Mining, Archival System, Maintainability, Archivist, Association Rule.

Introduction

Data mining is the process of extracting interesting non-trivial, implicit, previously unknown and potentially useful information or patterns from large information repositories such as relational database, data warehouses, XML repository and so on (Chen et. al., 1996; Zhao and Bhowmick, 2003). Data mining is also known as one of the core processes of Knowledge Discovery in Databases (KDD).

Association rule mining is an important component of data mining. Association analysis has been broadly used in many application domains. Traditionally, association analysis is considered as an unsupervised technique, so it has been applied in knowledge discovery tasks. Recent studies have shown that knowledge discovery algorithms such as association rule mining can be successfully used for prediction in classification problems. In these cases, the algorithm used for generating association rules must be tailored to the peculiarities of the prediction in order to build more effective classifiers (Moreno et al., 2005).

The U.S. Working Group on Standards for Archival Description defined archival system as "the process of capturing, collating, analyzing, organizing, and recording

information that serves to identify, manage, locate, and explain the holdings of archival institutions and the contexts and records systems from which those holdings were selected". Clearly, archival description is a complex matter, consisting of a number of inter-related activities required to manage archival materials throughout their existence. The International Council on Archives Commission on Descriptive Standards recognized that descriptive information is required at all stages of the management of archival materials, but narrowed its definition of archival system to cover "the creation of an accurate representation of the archival material by the process of capturing, collating, analyzing, and organizing any information that serves to identify archival material and explain the context and records systems which produced it". The 3rd International Symposium on Archival Training expressed the need, in the interest of both teachers and searchers, to put more emphasis on the study of the history of record keeping and archives at both national and international levels, (www.archivist.org/news/custardproject.asp).

The idea of keeping official documents is very old. Archaeologists have discovered archives of hundreds (and sometimes thousands) of clay tablets going back to the third and second millennia BC in sites like Ebla, Mari, Amarna, Hattusas, Ugarit, Pylos. Archives were well developed by the ancient Chinese, ancient Greeks and ancient Romans (who called them Tabularia). However, they have been lost, since documents were written on organic materials like papyrus and paper. On the contrary, many archives founded since middle age like churches, kingdoms and cities survive and often have kept their official status uninterruptedly till now, they are the basic tool for historical research on this age (Murray, 2009).

The history of archival thought in this century reflects the interaction of archival theory and practice as archivists everywhere have sought to preserve the archival system of the world (Cook, 1997). Former National Archivist of Canada and ICA President, Jean-Pierre Wallot has set the inspiring goal for archivists of "building a living memory for the history of our present". Historians in a postmodernist milieu are now studying very carefully the processes over time that have determined what was worth remembering and, as important, what was forgotten, deliberately or accidentally. Such collective "remembering" and "forgetting" occurs through galleries, museums, libraries, historic sites, historic monuments, public commemorations, and archives-perhaps most especially through archives (Cook, 1997).

Archival thinking over the century should be viewed as constantly evolving, ever mutating as it adapts to radical changes in the nature of records, record-creating organizations, record-keeping systems, record uses, and the wider cultural, legal,

technological, social, and philosophical trends in society. Archival ideas formed in one time and place reflect many of these external factors, which ideas are often reconstructed, even rediscovered in another time and place, or reshaped across generations in the same place. The best archival theorists are those who have been able to recognize and articulate these radical changes in society and then deal conceptually with their impact on archival theory and practice (Cook, 1997).

Exactly one hundred years ago, the Dutch trio of Samuel Muller, Johan Feith, and Robert Fruin published their famous Manual for the Arrangement and Description of Archives. Of course Muller, Feith, and Fruin's work did not spring to life in a vacuum during the 1890s. Archives in various forms had existed for centuries, but modern archival principles per se, despite some obscure precedents, were only articulated in detail in nineteenth-century France and Germany (Cook, 1997).

The existing system of keeping completed projects is not so organized. Energy is sapped and time is wasted because completed projects are just dumped in no orderly manner in a room. Due to the fact that they are not being orderly stacked, it makes the retrieval of a particular project to be difficult. Checking for a particular project for the purpose of studying or reviewing it may prove impossible in most cases.

In this paper, an Online Archival System for Managing Student's Projects was developed. The archival system is based on a Data Mining method called Association Rule Mining by using the Apriori algorithm and it was developed with Dreamweaver which embeds the functionality of PHP programming language and a query language called MYSQL.

Literature Review

Data Mining

Data mining, or knowledge discovery, is the computer-assisted process of digging through and analyzing enormous sets of data and then extracting the meaning of the data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases (Hemalatha et. al., 2016).

Data mining derives its name from the similarities between searching for valuable information in a large database and mining a mountain for a vein of valuable ore. Both

processes require either sifting through an immense amount of material, or intelligently probing it to find where the value resides. It is a powerful new technology with great potential to help companies focus on the most important information in the data they have collected about the behaviour of their customers and potential customers. It discovers information within the data that queries and reports can't effectively reveal. Data mining consists of five major elements:

- i Extract, transform, and load transaction data onto the data warehouse system.
- ii Store and manage the data in a multidimensional database system.
- iii Provide data access to business analysts and information technology professionals.
- iv Analyze the data by application software.
- v Present the data in a useful format, such as a graph or table.

Data Mining as a Process

Fundamentally, data mining is about processing data and identifying patterns and trends in that information so that one can decide or judge. Data mining principles have been around for many years, but, with the advent of big data, it is even more prevalent. Big data caused an explosion in the use of more extensive data mining techniques, partially because the size of the information is much larger and because the information tends to be more varied and extensive in its very nature and content. With large data sets, it is no longer enough to get relatively simple and straightforward statistics out of the system. The outline of the data mining process is shown in figure 1.

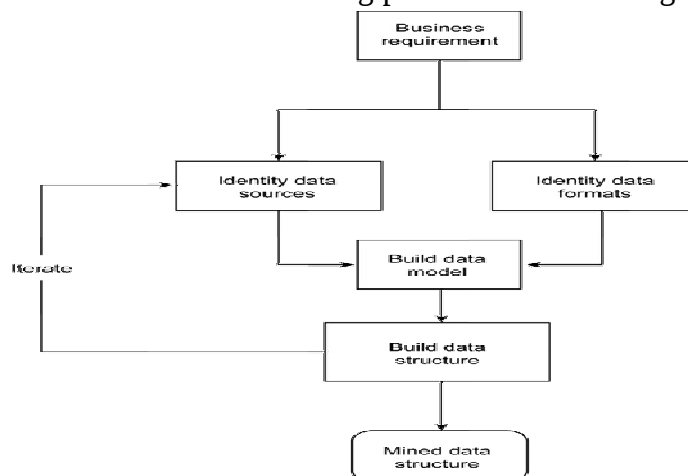


Figure 1: Outline of the Data Mining Process

Association Data Mining Approach

The Association Data Mining Approach was adopted in this paper. Association (or relation) is probably the better known and most familiar and straightforward data mining approach. Here, you make a simple correlation between two or more items, often of the same type to identify patterns. For example, when tracking people's buying habits, you might identify that a customer always buys cream when they buy strawberries, and therefore suggest that the next time that they buy strawberries they might also want to buy cream. Building association or relation-based data mining tools can be achieved simply with different tools. For example, within Info Sphere Warehouse a wizard provides configurations of an information flow that is used in association by examining your database input source, decision basis, and output information. The information flow used in association approach is shown in figure 2.

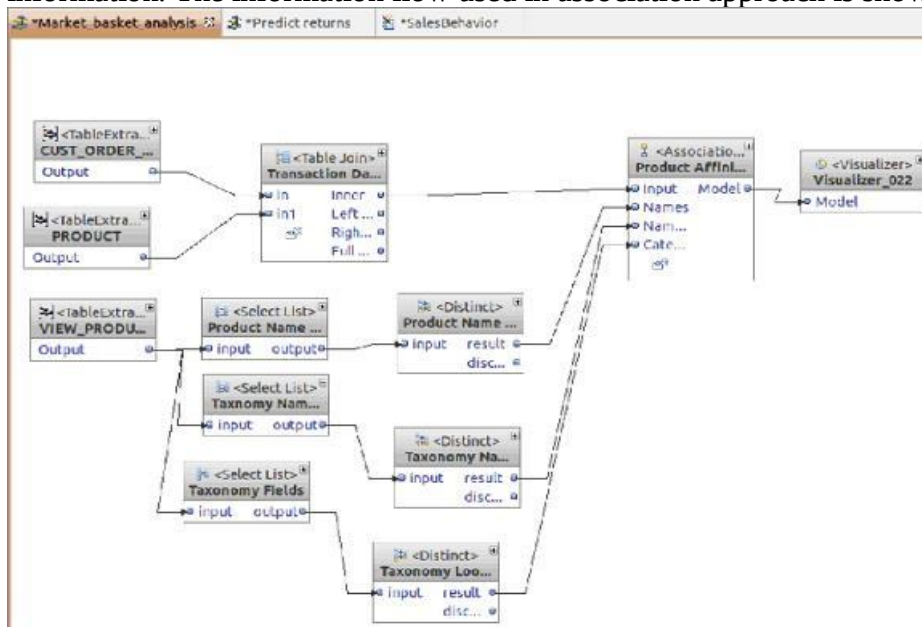


Figure 2: Information flow in Association Approach.

Important Concepts in Association Rule Mining

Association Rule Mining or induction is the extraction of interesting correlations, frequent patterns, associations or casual structures among sets of items in transactional databases or other data repositories (Sotiris & Dimitris, 2006). To select interesting rules for the set of all possible rules, constraints on various measures of significance and

interest can be used. The best constraints are minimum threshold on support and confidence.

Support of an Itemset

The support $\text{supp}(X)$ of an itemset X is defined as proportion of transaction in the dataset which contain the itemset. Mathematically,

$\text{Supp}(X) = \text{Number of Transactions which contain the item } X / \text{Total Number of Transactions}$

Confidence of a Rule

The confidence of a rule is defined:

$\text{Conf}(X \rightarrow Y) = \text{Supp}(XUY) / \text{Supp}(X)$

Frequent Itemset

Frequent itemset is an itemset that has a support higher than a user-supplied minimum support. Association rules are usually generated from frequent itemsets.

Generation of Association Rules

Association rule generation is usually split into two separate steps:

- I. Firstly, minimum support is applied to find all frequent itemsets in the dataset
- II. Secondly, these frequent itemsets and the minimum confidence constraints are used to form rules.

While the second step is straight forward, the first step needs more attention. Finding all frequent itemsets in a dataset is difficult since it involves searching all possible itemsets (item combinations). The set of possible itemsets is the power set over I and has size $2^n - 1$ (excluding the empty set which is not a valid itemset). Although the size of the power set grows exponentially in the number of items n in I , efficient search is possible using the downward-closure property of support (also called anti-monotonicity) which

guarantees that for a frequent itemset, all its subsets are also frequent and thus for an infrequent itemset, all its supersets must also be infrequent. Exploiting this property, efficient algorithms (e.g., Apriori and Eclat) can find all frequent itemsets.

APRIORI Algorithm Pseudocode

```
Procedure Apriori(T, minSupport) { //T is the database and minSupport is the minimum support
L1= {frequent items};
for(k= 2; Lk-1 !=∅; k++) {
Ck= candidates generated from Lk-1
//that is cartesian product Lk-1 x Lk-1 and eliminating any k-1 size itemset that is not
//frequent
for each transaction t in database do{
#increment the count of all candidates in Ck that are contained in t
Lk = candidates in Ckwith minSupport
} //end for each
} //end for
return UkLk;
```

Apriori uses breadth-first search and a tree structure to count candidate item sets efficiently. It generates candidate item sets of length k from item sets of length $k - 1$. Then it prunes the candidates which have an infrequent sub pattern. According to the downward closure lemma, the candidate set contains all frequent k -length item sets. After that, it scans the transaction database to determine frequent item sets among the candidates. The algorithm terminates when no further successful extensions are found.

Data Mining Tools

Recently, the very large data sets and the cluster and large-scale data processing are able to allow data mining to collate and report on groups and correlations of data that are more complicated. Now an entirely new range of tools and systems are available, including combined data storage and processing systems. Data can be mined with different data sets, including, traditional SQL databases, raw text data, key/value stores, and document databases. Clustered databases, such as Hadoop, Cassandra, CouchDB, and Couchbase Server, store and provide access to data in such a way that it does not match the traditional table structure.

In particular, the more flexible storage format of the document database causes a different focus and complexity in terms of processing the information. SQL databases impose strict structures and rigidity into the schema, which makes querying them and analyzing the data straightforward from the perspective that the format and structure of the information is known.

Data Mining Techniques

The analytical techniques used in data mining are often well-known mathematical algorithms and techniques. What is new is the application of those techniques to general business problems made possible by the increased availability of data and inexpensive storage and processing power. Also, the use of graphical interfaces has led to tools becoming available that business experts can easily use (Doug, 2011).

Examples of Data Mining Techniques are (Doug, 2011):

- Artificial Neural Networks: Non-linear predictive models that learn through training and resemble biological neural networks in structure.
- Decision Trees: Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset.
- Rule Induction: The extraction of useful if-then rules from data based on statistical significance.
- Genetic Algorithms: Optimization techniques based on the concepts of genetic combination, mutation, and natural selection.
- Nearest Neighbour: A classification technique that classifies each record based on the records most similar to it in an historical database.

Archival System The rise of ubiquitous computing has created a need for wide-area durable storage (Weather spoon et al., 2001). An online dictionary defines archive in three relevant ways: a place or collection containing records, documents or other materials of historical interest, a long-term storage area, often on magnetic tape, for backup copies of files or for files that are no longer in active use, and a file containing one or more files in compressed format for more efficient storage and transfer. The first definition is interesting because it is simply a place. The concept is applicable to the idea of layered storage in that one only cares to know the information has been stored and can be retrieved. The second definition might also be applicable to media content in the context of long-term, perhaps offline, storage. The third definition is not so much a place as it is a methodology for reducing the quantity of digital storage needed.

METHODOLOGY

In this paper, the Apriori Algorithm for Association Rule Mining was used on a Dreamweaver integrated development environment that embeds the functionality of

PHP and a query language called MYSQL. Association Rule mining is often used in conjunction with some measures such as, Support and Confidence. Association is used to find occurring patterns in many data (Devi and Sarojini, 2012). A random database of project archives would be generated and Association data mining approach was used in the process. The Association approach used in this paper helps when a search is being made on a particular project topic; the result of the search brings out all topics relating to the search item. For example a search on a web based project brings out results on all web related projects in the archive.

The Apriori Algorithm that was proposed by Agrawal and Srikant (1994; 1995) was used in this study. This approach is an iterative process. Each iteration has two steps;

Step 1: To generate a set of candidate item sets.

Step 2: To prune all the disqualified candidates (such as, all infrequent item sets)
Using data mining approach to archival system on completed project enables one to get a large amount of information on different completed projects and finding the one that fits in best for the intended purpose.

System Analysis

System analysis can be defined as the process of analyzing a system with the essential goal of improving or modifying it. It can also be defined as the methodical study of a system, its current and future required objectives, and procedures in order to form a basis for the system design. The purpose of analysis is to produce a clear requirement specification of the newly designed or upgraded system efficiently and effectively. It requires the ability to analyze the essential features of a system. This knowledge of a system is achieved through the investigation of the system and its environment.

Analysis of the Existing System

The current that is the existing system of retrieving completed projects does not enhance research because a particular project might have been done consecutively. Because of the poor archival system of these projects, a supervisor may not know that a particular project was recently done, and he/she would just approve that the same project again. Figure 3 shows shelved record boxes of projects.



Figure 3: Shelved Record Boxes (www.wikiwand.com/en/archive). (1505 × 1204
madison-historical.siue.edu).

The use of the existing system of storing completed projects is old as students have to exhaust their energy and time in search of existing projects. On the shelved record boxes as shown in figure 3, there are quite a number of completed projects. It could therefore take a lifetime for a student to know which one will actually be of paramount usefulness to him or her.

Description of the Proposed System

The proposed archival system needs proper analysis and careful design before implementation as the overall goal is to develop a scalable, high performance archive of completed projects. The system design describes and various operations such as the screen layout, images and others. The emphasis of system design is how to develop a new system that helps to achieve the goal and objectives of archival system of completed projects and overcome some of the shortcomings or limitation of the existing system. The system design is used to structure the architectural requirements to develop a system which has undergone the best possible design stage of turning the design to its efficient, best performance and accurate level of interaction.

Improvement of the Proposed System over the Existing System

The proposed system is one of the most relevant storage solutions today. It is aimed at modifying the shortcomings of the existing system. Even the Library where completed projects are stored manually is in constant need of storage space. This is made tougher due to the rising rate of completed projects. It does not speak well of a library if it needs to store documents such as projects outside its workspace. Even businesses today are making use of archival storage facilities in order to store their documents and files. For any business, it is important to store your documents neatly and in an organised manner. For this reason, archival storage systems are essential for an efficient office.

On the supervisor's part, the improvement of the proposed system over the existing system helps to know if a particular project has been done especially for projects that have been flooded. It reduces repetition of project topics thereby helping students to be able to sit down, think very well and come up with a reasonable project topic. This is a logical step as the proposed system minimizes the clutter in the supervisor's office in cases where students have to come with hard copies of their completed projects and saves the space which can be utilised for other important purposes. The proposed system facilities have extensive storage methods where projects are stored in a completely secured area which is fire and flood proof.

Other significant improvements of the proposed system over the existing system are: documents can be retrieved easily as at when needed, it reduces the time students spend to consult past projects manually, it aids research, eliminates time wastage, it reduces stress for both students and supervisors, maximum security of projects is guaranteed, it is easy to access and so convenient. It is mobile.

System Design

System design comes after the analysis. It allows the researcher to put to reality all the information gotten from the analysis stage. It is a process whereby definite specification of a system are produced. System design can further be discussed under the following categories: preliminary design and structured design.

Preliminary Design

The proposed system is designed with the idea of simplicity. The system is responsible for the storage of information such as projects which include the date of completion of the project and the supervisor's name. The system will make information on the desired project available as at when needed.

Structural Design

The design of the system is structured in such a way that allow various project searches to be displayed after imputing the first two characters and after the searches have been displayed you can then click on view and the desired search output will be displayed. The projects are being displayed in Pdf format. The figure 4 shows the schematic flowchart of the proposed system.

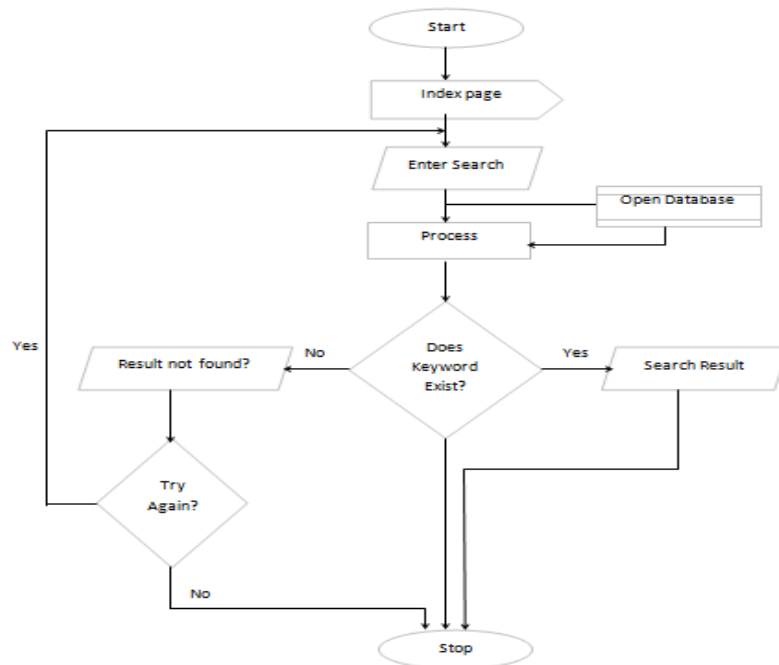


Figure 4: Schematic Flow Chart of the Proposed System.

Menu Design

The computer and other components must be correctly connected. The computer should be powered on and wait until it finishes booting into the windows environment. A web server need to be started either locally or remotely. Once the project folder is placed in the web server directory, the user needs to locate it by typing "LOCAL HOST" into the address bar of a typical browser, where all available project folders will be listed. The user checks on the archival system project folder which automatically loads the index page that contains a simple search text field, where users are preamble with "Type Your Search Here". As user types in these search keywords, after the third (2nd) letter of word, it indexes search result where users can click and access needed documents. The search text box helps to look for a particular word or sentence as the user types in it. This was accomplished through the use of the Query.

Input Design

The input design explains how data are gathered into the system or the ways data are organized in order for the successful processing state. This design of input focuses on how the search word is being processed.

Output Design

The output design is developed to meet the system design requirements and present the query result clearly. Efficient and intelligent output design improves the system's relationship to help the user experience desired result like it is done in the archival system of completed projects. The output design is made hidden before the query of the project topic is input in the search textbox, once an entry is made into the search box, the corresponding output as regard the search is with details below the search box.

Database Design

A database design is an organized mechanism that has the capability of storing information through which a user can retrieve, update and store information in an efficient and effective manner.

Results

Screen shots displaying the interface of various modules of the Online Archival system are shown in this section.

1. Search Page: Upon launching the system, the first page to be displayed is the search page which is shown in the figure below 5. This is where queries are entered in terms of project titles or name of authors.



Figure 5: Search page

2. Search Result: After a search query is entered in figure 5, a search result showing similar or related project topics will be displayed as shown in figure 6.

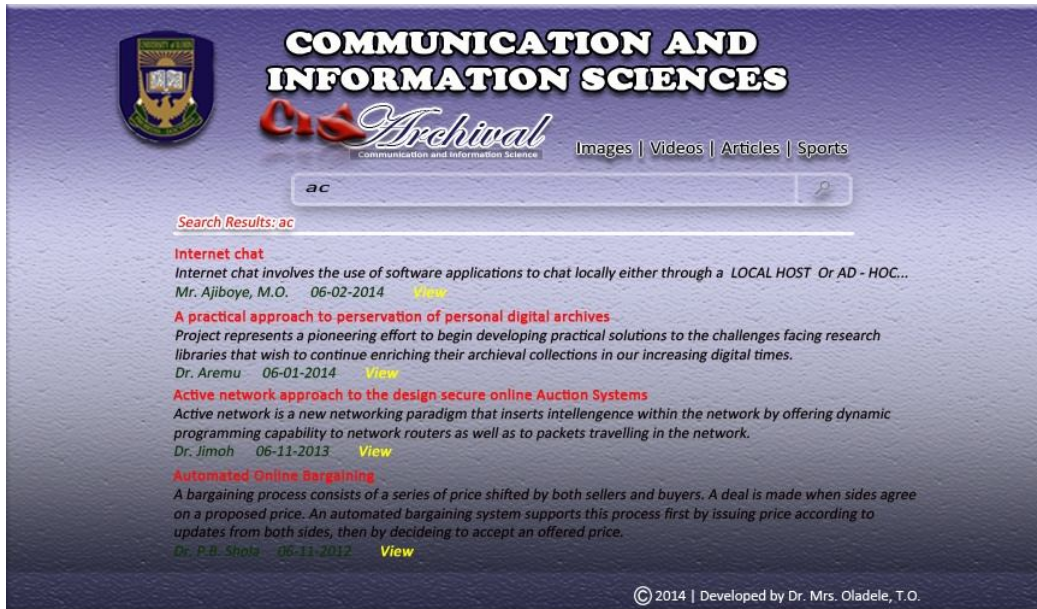
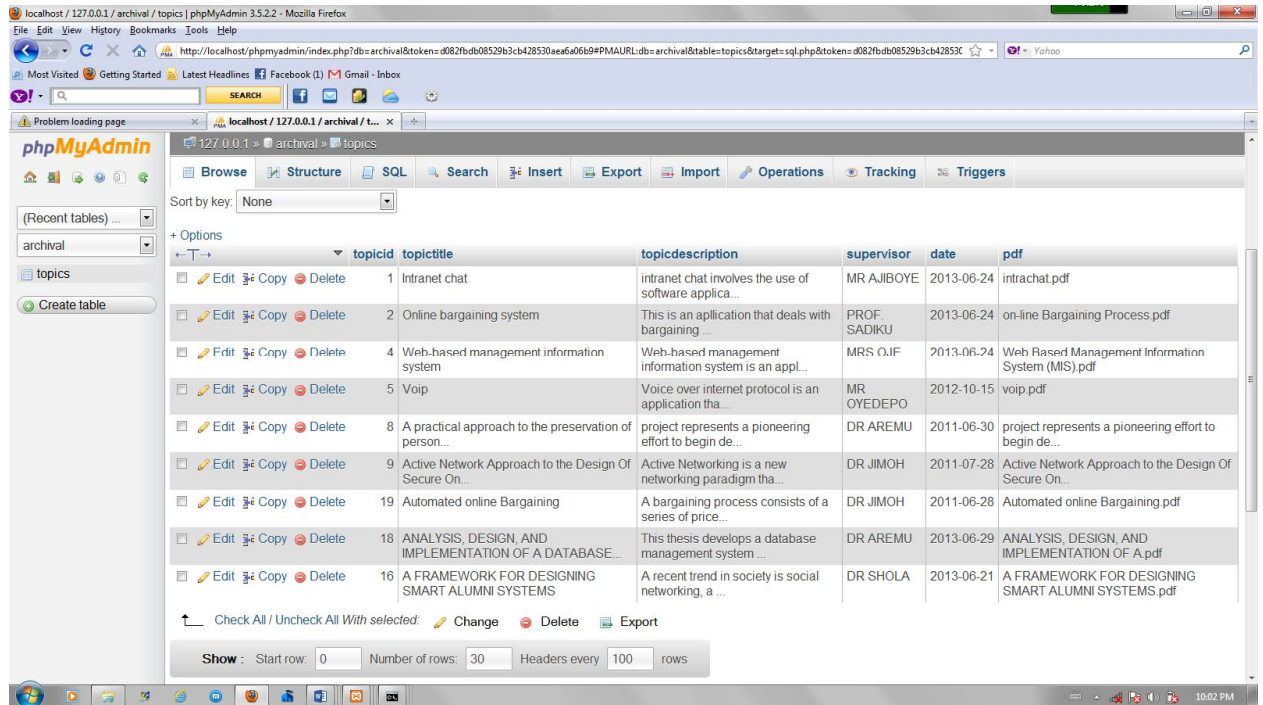


Figure 6: Search Result

3. Data is the purpose of any database and it must be protected. This module shows how queried data are stored in the database. Figure 7 shows how the database has been designed to store completed projects through a created table.



The screenshot shows the phpMyAdmin web interface in a Mozilla Firefox browser. The interface displays a table named 'topics' with the following data:

topicid	topictitle	topicdescription	supervisor	date	pdf
1	Intranet chat	intranet chat involves the use of software applica...	MR AJIBOYE	2013-06-24	intrachat.pdf
2	Online bargaining system	This is an application that deals with bargaining ...	PROF. SADIKU	2013-06-24	on-line Bargaining Process.pdf
4	Web-based management information system	Web-based management information system is an appl...	MRS O.IF	2013-06-24	Web Based Management Information System (MIS).pdf
5	Voip	Voice over internet protocol is an application tha...	MR OYEDEPO	2012-10-15	voip.pdf
8	A practical approach to the preservation of person...	project represents a pioneering effort to begin de...	DR AREMU	2011-06-30	project represents a pioneering effort to begin de...
9	Active Network Approach to the Design Of Secure On...	Active Networking is a new networking paradigm tha...	DR JIMOH	2011-07-28	Active Network Approach to the Design Of Secure On...
19	Automated online Bargaining	A bargaining process consists of a series of price...	DR JIMOH	2011-06-28	Automated online Bargaining.pdf
18	ANALYSIS, DESIGN, AND IMPLEMENTATION OF A DATABASE...	This thesis develops a database management system ...	DR AREMU	2013-06-29	ANALYSIS, DESIGN, AND IMPLEMENTATION OF A.pdf
16	A FRAMEWORK FOR DESIGNING SMART ALUMNI SYSTEMS	A recent trend in society is social networking, a ...	DR SHOLA	2013-06-21	A FRAMEWORK FOR DESIGNING SMART ALUMNI SYSTEMS.pdf

Figure 7: Database of Stored Projects.

Conclusion

An online archival system for project management is presented in this paper. This is aimed at promoting the management and use of records and archives and to make materials on completed projects available to all researchers and students and also supervisors who may profit and benefit from the use of its holdings. This paper on Data Mining Approach to Archival System of Completed Project is for a scalable, high performance archive of completed projects. The application makes materials on completed projects available to students and supervisors. This system is a very efficient one which eases the stress of consulting past projects manually.

Recommendations

After carefully studying the problems associated with the manual archival system, concerted efforts were made to solve the problem by providing an online storage medium for completed projects. The following recommendations are made concerning the proper utilization of the system: Great awareness should be made concerning the use of the newly designed system. It should be implemented in the University Library and in all Departments of the various Faculties in the University. It should be updated with

more completed projects at least once in a session. This should be done preferably at the end of every session.

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- Madison Historical – Online Encyclopedia and Digital Archive for ...