

New Trends in Science, Technology, Management and Social Sciences in Africa Kanu, Omojola & Asanbe (Eds)

New Trends in Science, Technology, Management and Social Sciences in Africa

Proceedings of the
Third International Conference of
Villanova Polytechnic, Imesi-Ile
2nd - 4th June, 2021



Editors

Kanu, Ikechukwu Anthony OSA
Omojola, Immaculata
Kanu, Catherine Chiugo
Asanbe, Michael
Kanu, Emmanuel Uchenna

In Collaboration with
Association for the Promotion of African Studies



Proceedings of the 3rd International Conference on
New Trends in Science, Technology, Management and
Social Sciences in Africa.



In collaboration with



2nd - 4th June, 2021,
Villanova Polytechnic, Imesi-Ile,
Osun State.

Editors

Kanu, Ikechukwu Anthony OSA
Omojola, Immaculata
Kanu, Catherine Chiugo
Asanbe, Michael
Kanu, Emmanuel Uchenna

© 2021 Villanova Polytechnic

ISBN: 978-978-991-434-0

Published by: Villanova Polytechnic
Imesi-Ile, Osun State, Nigeria

Cover Design: Emmanuel Uche Kanu

Typesetting & Print Production: Altograde Nigeria Limited, Yola

Contents

Preface	iv
Rector's Address	1
Prof. Kanu, Ikechukwu Anthony, Osa	
Keynote Address	2
Rev. Fr. Peter Adeyemi Phd	
Impact of Security Lock-down on Education in Southwestern Nigeria	5
Prof. Kanu, Ikechukwu Anthony (osa) & Dr Omojola Immaculata Olu, (ssma)	
Organizational Structure in the Polytechnics: Yaba College of Technology, A Test Case!	15
Otunba Peter S. Adekanla	
Impact of ICT on the Effective Teaching in Selected Secondary Schools in Akoko North Local Government Area of Ondo State.	22
Asanbe M.o & Olagunju M.p	
The Impact of Staff Motivation on the Performance of an Organization	38
Abimbola E.O	
Face Based Access Control System For Document Identification	46
Oni, E. O & Oketoyan, R.b	
Managerial Scheduling As Correlates Of Administrative Effectiveness In Higher Institutions In Ekiti State, Nigeria	55
Prof. Kanu, Ikechukwu Anthony (osa) & Dr. Omojola Immaculata Olu, (ssma)	
Issues and Trends in Science Education For Sustainable Economic Development in Nigeria	62
Bello, Moruff Ajadi	
The Impact of Social Media on Education and Society	78
Komolafe Taiwo	
Algorithm and Flowchart: Twin Brothers as Tools for Optimization	85
Yusuf, Abdulkawiyu K; Abdul-hameed, Taofeek A & Tijani, Oluwafemi M	
Development of a Strategic Hospital Information Management System	96
Odeniyi O. A; Akinwumi A. R; Makinde B. A & Oyeniran O. R.	
Design and Implementation of an Electronic Mosquito Repellent	118
Yusuf, Abdulkawiyu K & Sanusi, Mufutau. A	
“Fresh Air and Sunshine” Going Back to the Old Ways in the Face of Influenza Pandemic.	129
Njemanze Izuchukwu William	
Cleanliness is Next to Godliness: Implications for Extraordinary Ministers of Holy Communion in the Catholic Church	132
Omojola Immaculata Olu, (SSMA), Phd	
Industrial Conflict and its Effects on Workplace Efficiency	137
Smart Mokuye	
Lycorine: Prospective Natural Cure for Zika Virus Infection	156
Umoke Toochukwu	
Physics of Failure and its Role in Maintenance	161
Idoko Sunday Agada	
Development of a Remotely Controlled Car Speed Limiter on Highway	180
Oni, E. O & Olawuni, A	

Preface

This proceedings captures a three-day program of presentations, panel discussions and interactive dialogue at the Third International Conference of Villanova on New Trends in Science, Technology, Management and Social Sciences in Africa, which took place from 2nd to 4th of June 2021. The event was a multidisciplinary conference that brought together some academics, researchers and scholars from various academic institutions from within and outside the state as well as the academic staff of Villanova Polytechnic to review new trends virtually in all fields of learning. It also provided a valuable networking opportunity and set the stage for further cooperation among academics, researchers and scholars in the state and beyond. The Conference was highly competitive, with 22 paper submissions. Of these, 17 were accepted as full papers. This third conference featured lead paper presentation by Rev Fr Dr Peter Oluseyi Adeyemi. We are thankful to the conference committee and regular program committee members and reviewers, without whose expert input this conference would not be possible. Finally, we thank the entire organizing team and all authors who submitted their work. We hope that you will enjoy this collection of high quality papers and research notes researchers in the fascinating field of Science, Technology, Management and Social Sciences.

MOKUYE S. -LOC Member

ASANBE M.O. - LOC Secretary/Member

Sr. Dr. OMOJOLA Immaculata Olu, SSMA - LOC Chairperson

Very Rev. Fr. Prof. KANU Ikechukwu Anthony, OSA - Convener

PREFACE

This proceedings captures a three-day program of presentations, panel discussions and interactive dialogue at the Third International Conference of Villanova on New Trends in Science, Technology, Management and Social Sciences in Africa, which took place from 2nd to 4th of June 2021. The event was a multidisciplinary conference that brought together some academics, researchers and scholars from various academic institutions from within and outside the state as well as the academic staff of Villanova Polytechnic to review new trends virtually in all fields of learning. It also provided a valuable networking opportunity and set the stage for further cooperation among academics, researchers and scholars in the state and beyond. The Conference was highly competitive, with 22 paper submissions. Of these, 17 were accepted as full papers. This third conference featured lead paper presentation by Rev Fr Dr Peter Oluseyi Adeyemi. We are thankful to the conference committee and regular program committee members and reviewers, without whose expert input this conference would not be possible. Finally, we thank the entire organizing team and all authors who submitted their work. We hope that you will enjoy this collection of high quality papers and research notes researchers in the fascinating field of Science, Technology, Management and Social Sciences.

MOKUYE S- LOC Member

ASANBE M.O - LOC Secretary/Member

Sr Dr OMOJOLA Immaculata Olu, SSMA- LOC Chairperson

Very Rev Fr Prof. KANU Ikechukwu Anthony, OSA- Convener

**RECTOR'S ADDRESS AT THE THIRD INTERNATIONAL CONFERENCE OF
VILLANOVA POLYTECHNIC, IMESI ILE**

Prof. KANU, Ikechukwu Anthony, OSA
Rector Villanova Polytechnic Imesi Ile

Distinguished guests, respected colleagues, ladies and gentlemen, good morning and very warm welcome to the Third International Conference of Villanova Polytechnic: a centre of academic excellence and a citadel of learning and research.

We have gathered together today to deliberate as an academic community of inquiry on the new trends within the parameters of Science, Technology, Management and Social Sciences. Our yearly International Conferences was begun in 2019 with the objective of creating a conducive academic forum where scholars of all levels and interests, can come together to discuss contemporary issues of concern within the parameters of science, technology, social sciences and humanities, and if possible find solutions to them. Added to this is the objective of accessing a wonderful opportunity to renew long-standing acquaintances, and the aperture to connect with a person or group of persons we had not met before. Herein, we hope to find valuable insights and opportunities for collaboration and innovation.

Honorable colleagues, William Shakespeare writes that: "There is a tide in the affairs of men, which taken at the flood, leads on to fortune. Omitted, all the voyage of their life is bound in shallows and in miseries. On such a full sea are we now afloat. And we must take the current when it serves, or lose our ventures". This Shakespearean metaphor, means that there is an occasion in each person's life when he or she must commit himself or herself to a course of action that would lead to success. I think that the 2021 Villanova International Conference on "New trends in science, technology, management, and social sciences in Africa", is one of such tides in our history when we as African scholars must rise to the challenge to critically study the issues of concern and trends/advances obtainable in Africa and beyond.

I, therefore, convey the Institution's profound and affectionate sentiments of welcome to the keynote speaker: Rev. Fr. Dr Peter Adeyemi. On behalf of this citadel of learning, I further appreciate the presence of Dr Adeyemi who would be setting the parameters for our discussions today. I also welcome all of you: our distinguished guests, Conferees, staff and students- as we all look forward to an edifying International Conference. Special appreciation goes to the members of the Local Organizing Committee chaired by Rev. Sr. Dr. Immaculata Omojola, SSMA and the Executive Secretary of the LOC, Mr Asanbe Michael for accepting this responsibility.

Long live Villanova Polytechnic!! And welcome once again to Villanova Polytechnic Third International Conference.

**KEYNOTE ADDRESS DELIVERED FOR THE 2021 VILLANOVA
POLYTECHNIC INTERNATIONAL CONFERENCE**

New Trends in Science, Technology, Management and Social Sciences in Africa

Rev. Fr. Peter Adeyemi PhD (Ife)

Introduction:

The frontiers of knowledge in all disciplines are being pushed to the maximum elastic limits all over the world, especially in the areas of Science and Technology. The capacity of any scholar or researcher to keep pace with the advancements in science and technology is grossly limited to the field of specialization of the individual, or else he/she risks being a mediocre. It is in the light of this, that cross fertilization of ideas and sharing of new discoveries at conferences remains sacrosanct and irreplaceable.

I warmly welcome all the participants to this year's Villanova Polytechnic Webinar International Conference online. It is my ardent hope that contributors from a broad spectrum of scholarly backgrounds will open up new vistas in their areas of specialization and offer fresh insights to old problems, as well as come up with solutions to the problem of technological under development in Africa.

Global New Trends in Technology, Management and Social Sciences:

We live in the digital age which has significantly affected the way things are done positively with some grey areas in human experience. Africa as a continent is far behind in technological advancement compared to the western countries. Our technology at best can still be described as subsistent. The level of technology in Africa is still at a level that our engineers and scientists celebrate the manufacturing of *Garri* and palm oil processing machines.

The rest of the world has left Africa behind, recent technological advancements include: Quantum computers which will gain supremacy over super computers. The quantum computer is capable of genetic profiling, useful in the search for extraterrestrial intelligence, space travel etc.

While African countries are still struggling to construct wheel chairs for the physically challenged people, Louis Marinelli of Hobbs Rehabilitation Center in Winchester has invented "Exoskeletons" to help people who are paralyzed to walk. The device is strapped to the patients' back, hips, legs and feet to help them stand and walk. Still on health sciences, scientists in Edinburgh's Roslyn Institute based on CRISPR technology, have invented "Gene editing device" using synthetic cell that can edit diseases out of human DNA. Meanwhile, our roll back malaria scheme in Nigeria is still based on sharing of mosquito nets. While our people patronize local bone setters, the civilized world now thinks about manufacture of bionic body parts and telemedicine.

In the area of Robotic Engineering, "Robo Brain" is a project funded by Google and Microsoft companies at Stanford and Cornell Universities in United States of America to develop robots with super brains stored up in the online cloud. These manufactured robots will have intellectual cloud and be smarter and more flexible in the jobs attached to them. Google cloud and Amazon cloud both have robot brains

that are capable of learning and “growing” i.e increase the information available to them. The goal is to manufacture robots that can see, hear and comprehend natural language and respond intelligently to the world around them. In Nigeria we are still struggling to settle the frequent bloody clashes between Fulani wandering cattle herders and farmers using hoes and cutlasses to farm.

What technological advancement are we talking about in Africa? Nigeria the giant of Africa is celebrating constructions of light rail lines by Chinese contractors with made in China equipments from Lagos to Ibadan and Kaduna to Abuja, when America Space Engineers are already working on landing a man on the planet Mars before 2040. The scientists are already working on fungi fabricated structures that will enable mushrooms to grow on another planet. Machinery is already in place to send equipments to space that will allow scientist cultivate food and water in outer space.

In the area of digital technology, researchers are already working on synthetic media, which will undermine reality. There is the “deep fake technology” capable of artificially generated photos, text, sound and video, through this technology, the face of an individual can be switched into an existing video scene and appear natural to the original setting.

Cyber security generates three times the job opportunities than other sectors and in 2021 alone 6 trillion dollars will be spent worldwide on cyber security, most African countries still struggle with electricity supply, they are obviously cut out of this huge economic advantage. How many Polytechnics in Nigeria train Ethical Hackers, Malware Analysts and Security Engineers?

All the technological areas identified have significant impact on management sciences and businesses globally. In the race for global survival, Africa as a continent is a colossal failure. The trending technological advancements in Africa belong in the Stone Age era of humanity. I do hope that the scholars and researchers that will participate in this conference will prove me wrong by coming out to present their discoveries in their fields of specialization that will rival the areas identified trends in global world of technology.

The Way Forward in Nigeria

The purpose of Polytechnic education is to promote entrepreneurship, but sadly in Nigeria there is poor promotion of Polytechnic education. The curricular for different programmes are hardly followed; equipments for studies are not available and worst still the standards obtainable are compromised. Polytechnics should not be relegated to the background for the nation to tag along with the rest of the world in area of technology.

The government should pay serious attention to Polytechnic education. A purpose driven investment in Technical and vocational education will help grow the economy and reduce our over dependence on importation of goods in Nigeria.

Undoubtedly, the greatest challenge facing the vast majority our productive population in the country is unemployment. A recent report by the National Bureau of statistics show that unemployment Rate in Nigeria is the second highest in the world estimated to be 33.3 percent, about 23.2 million of the working demography of Nigeria are jobless. If Polytechnics are adequately funded and the programmes are

implemented to standard, Nigeria / Africa will take millions of jobless youths off the streets into decent living and dignified existence.

Conclusion

For Africa to develop in area of technology, African leaders should rise up to overcome poor leadership indices, bad economy, lack of problem-solving policy, lack of basic infrastructures that can support researcher and they must create a conducive environment for vocational and technical education. In our tertiary institutions, the relevant government ministries must ensure, highly qualified faculty, excellence in research, quality teaching, high levels of government and non-government sources of funding of vocational and technological education. I wish all participants in this conference a fruitful intellectual exercise and a vibrant discussion that will bring about development in the technological growth of Nigeria and Africa in general.

Thank you listening.

God bless.

IMPACT OF SECURITY LOCK-DOWN ON EDUCATION IN SOUTHWESTERN NIGERIA

Prof. KANU, Ikechukwu Anthony (OSA)

Department of Philosophy and Religious Studies

Tansian University, Umunya

Anambra State

ikee_mario@yahoo.com

&

Dr OMOJOLA Immaculata Olu, (SSMA)

Department of Business Administration and Management

Villanova Polytechnic, Imesi-Ile, Osun State

omojolassma@yahoo.co.uk

Abstract

Education in Nigeria has been relatively stable apart from regular strike actions of the academic staff union of universities (ASUU) and students' unrest in some universities. However, in the recent past, especially in the year 2020 (2019/2020 academic year), there have been series of interruptions occasioned especially by the covid-19 lock-down. This has caused a whole academic year to be lost, thereby causing disruption in the respective academic calendars. This article therefore, examined the impact of these lock-downs, a security strategy of government on education in Nigeria. The paper is hinged on the following three-fold objectives: First, to conceptualize security lock-downs; second, to examine how these series of lock-downs affected educational activities in Nigeria, and third, come up with workable strategies to reposition the state of the educational sector in Nigeria. The paper adopted Phenomenological method of research and was analyzed with descriptive and content analysis. The study findings revealed that, apart from the covid-19 lock-downs and its attendant effects on the educational sector, the security situation in the country has had its tolls on educational operations in the country. The article concluded that, an effective e-learning method that is backed up with workable policies, may rectify this imbalance in the educational sector of this country.

Keywords: Security lock-downs, Educational Sector, E-learning, Covid- 19 pandemic, #Endsars, curfews, ASUU, Strike actions.

1. Introduction

Lockdown was government's intervention to secure lives of citizens in the event of the covid-19 pandemic. The measure, which required that people stayed indoors to guard against being infected by the dreaded disease, or get some health complications resulting therefrom, put a stop to all outdoor activities including general educational operations. Both students and all workers within the educational sector could not go to school for the period of the lockdown, which was in phases, lasted. Though all sectors of the Nigerian state had its fair share of the effects of the lockdown, with attendant losses, the educational sector witnessed a total disruption in the curriculum and sessions of the different institutions. Some institutions, realizing that it could not adjust the 2019/2020 academic session, for instance, had to cancel the ill-fated year and begin a fresh 2020/2021 academic session.

It should be kept in mind that, it took government a long time to come up with decision as to when schools should resume classes. This is against the backdrop of governments' concern for the health of the children especially, who are considered vulnerable. Even the Academic Staff Union of Universities (ASUU) was vehemently against early reopening when some state governments, especially Lagos, were inching to reopen. At this time government at the centre insisted that it had not given directives for schools to reopen. It claimed it was more concerned with the health of the children.

However, when the pressure was much even from private school owners, parents, and other stake holders within the school sector, government had to succumb to pressure, but with a *proviso* that schools should adopt a line-up of conditions especially the provision of all covid-19 safety rules, namely: wearing of facemask by both students and staff, making available regular handwashing material, alcohol-based sanitizers, social distancing. But when schools finally reopened, both parents, students themselves, school owners, were already counting their losses occasioned by the serial lockdowns.

Therefore, whereas the lockdowns in Nigeria was said to ensure the security of the health and lives of citizens, the impacts and implications of this serial sit-at-home order were quite enormous on sectorial basis. Hence this paper seeks to ascertain these impacts especially on the education sector in Nigeria.

Literature Review

2.1 Conceptual Clarifications

Security lockdowns is taken, in this study to refer to a measure taken by governments the world over in the wake of the covid-19 pandemic, mainly to prevent people from contracting the virus. It a total halt of all human outdoor activities. The measure required that people stayed indoors for specified number of days or weeks as deemed fit. Though the lockdown was in phases, the cumulative effect on the different sectors was immense. On the economic sector, business activities were brought to a halt during the period and it got to a time that it became unbearable. Government was supposed to provide palliatives to cushion the effect of the lockdown, but was not evenly distributed within the region (southwestern Nigeria) covered by this study.

Whereas the purpose of the lockdown was to secure the life of people from the ravaging virus, it nevertheless had devastating effects on the society such as hunger, disruption of academic calendar and curriculum, among others. A World Bank report, *Policy Brief: Education during COVID-19 and beyond* (2020) states that, the COVID-19 pandemic had created the largest disruption of education systems in history. On a global level, the report gave a conservative figure of nearly 1.6 billion learners being affected in more than 190 countries and all continents. Closures of schools and other learning spaces have impacted 94 per cent of the world's student population, with up to 99 per cent in low and lower-middle income countries. The report states further that, the crisis resulting from the pandemic was exacerbating pre-existing education disparities by reducing the opportunities for many of the most vulnerable children, youth, and adults – those living in poor or rural areas, girls, refugees, persons with disabilities and forcibly displaced persons – to continue their learning. The report

stressed that learning losses also threaten to extend beyond the present generation and erase decades of progress. Some 23.8 million additional children and youth (from pre-primary to tertiary) may drop out or not have access to school in 2021 due to the pandemic's economic impact alone. In like manner, the education disruption has had, and will continue to have, substantial effects beyond education. The multiplier effect of closures of educational institutions hamper the provision of essential services to children and communities, including access to nutritious food, affect the ability of many parents to work, and increase risks of urban violence.

Citing the *World Bank Report (2020)* further, the disruptions caused by COVID-19 to everyday life meant that as many as 40 million children worldwide have missed out on early childhood education in their critical pre-school year. They thus missed a stimulating and enriching environment, learning opportunities, social interaction and in some cases adequate nutrition. This is likely to compromise their longer-term healthy development, especially those children from poor and disadvantaged families. In technical and vocational education and training systems, vulnerabilities including low levels of digitalisation and long-standing structural weaknesses, have been brought to light by the crisis. Disruptions in work places made it difficult to implement apprenticeship schemes and work-based learning modes, key elements of a functional and market-responsive technical and vocational system. In the higher education sub-sector, while online learning has generally taken place through recorded lectures and online platforms, some universities have postponed learning and teaching until further notice, due to the lack of information technology (IT) infrastructure for both students and teachers. Questions also remain about how to harmonise

2.1.1 Impact of School Closure (as a result of security lockdowns) on Children

School attendance is one of the best public tools available to raise a child's skills, awareness and ability. However, this long period of school closure had significant consequences on skill acquisition and growth of school children. It is worthy to note that schooling provides adequate learning but when schools close, children are deprived the opportunities for academic growth as well as academic development. The disadvantages of school closures are enormous for under-privileged students who tend to have fewer or no educational opportunity outside school.

The closure of schools, colleges and universities does not only interrupt the teaching of students around the world, it also coincides with a key assessment period and many examinations have been postponed or cancelled as a result of COVID-19. For instance, Cambridge International Examinations that include Cambridge IGCSE, Cambridge, O Level, Cambridge International AS and A Levels, Cambridge AICE Diploma and Cambridge Pre-University examinations for May/June 2020 diet were canceled worldwide as well as NECO SSCE, GCE 2020, UTME_2020. Though candidates could be awarded grades based on the forecast grades sent by their teachers, to some extent, this would not represent the true performance of the candidates as some teachers may be biased and either over-grade or under-grade their students while predicting scores for them. Other International examinations that were canceled due to COVID-19 include International Baccalaureate, Scholastic Aptitude Test (SAT) and American College Test (ACT).

Apart from these, students who sat for Senior Secondary Certificate Examination (WAEC) in the West African countries had their examinations postponed. The implications of this on candidates is that, thousands of students will be forced to defer the start of their studies for their undergraduate studies to a later year.

Without mincing words, the Covid-19 pandemic has caused the largest disruption of education in history, having already had a near universal impact on learners and teachers around the world, from pre-primary to secondary schools, technical and vocational education and training (TVET) institutions, universities, adult learning, and skills development establishments. By mid-April 2020, 94 % of learners worldwide were affected by the pandemic, representing 1.58 billion children and youths, from pre-primary to higher education, in 200 countries. The ability to respond to school closures changes dramatically with level of development: for instance, during the second quarter of 2020, 86 % of children in primary education have been effectively out of school in countries with low human development – compared with just 20 % in countries with very high human development.

A UKAID (2020) report of a survey of the experiences and opinions of educators and technology specialists, *The effects of covid-19 on education in Africa...*

Writing on: *Coronavirus (Covid-19): The Lockdown Strategy in Nigeria*, Ekienabor Ehijiele (2020) stated that, authorities around the world had resorted to the lockdown strategy to curb the spread of the virus. Therefore, the study aimed at investigating the effect of the lockdown strategy in curbing the spread of the COVID-19 virus and its multiplier effects especially on the educational sector in Nigeria.

2.1.2 Phases of Lockdown in Nigeria

The primary aim of lockdowns is to flatten the covid-19 curve through a persistent reduction in the confirmed cases, and ensure the those infected by the virus quickly recovered from the virus. During lockdown people are expected to stay at home. Also, location of contacts such as schools, (including polytechnics and universities), hotels, clubs, and religious centres are closed, social gatherings involving above 20people, are prohibited and economic activities involving physical interactions are halted. (*World Bank Group, 2015*)

The guideline for the second phase of lockdowns which was in place between June 2nd and 29th 2020, include that: nationwide curfew remained in place, but the time changed to from 10:00pm to 4:00am daily. Healthcare workers and journalists are exempted from the curfew. Banks may resume normal working hours. However, this second phase was extended by the President, Muhammadu Buhari for four more weeks.

Following the global practice, a nationwide lockdown was announced in Nigeria on 30th march 2020 to take immediate effect in three states of the federation, namely: Lagos, Ogun and Abuja. This was further extended for two weeks with the inclusion of Kano on 27th April, 2020. Thus, the first phase of lockdown in Nigeria was announced by the President on 27th April, 2020 with effect from May 4th to 17th, 2020 spanning two weeks in FCT, Lagos and Ogun states.

2.1.3 Impact of Covid-19 on Education in Sub Saharan Africa

Covid-19 deadly disease has resulted to total shutting of schools in about 215 countries all over the world with 91.4% of the total number of enrolled learners in these countries momentarily mandatory out of school (UNESCO, 2020). It is accounted that over 1.6 billion students transversely the world which are presently obliged to stay out of schools as social distancing is being enforced locally and regionally around the world in order to enclose the extent of coronavirus disease. Besides, statement shows that lockdown of schools is added importance in some continents such as Africa, South America and in some parts of Europe (UNESCO, 2020).

It can be said that Africa is one of the continents which educational systems have been typically affected by the deadly disease as more that 98% of teaching and learning cannot be performed suitable to country-wide lockdown in these continents in the shutting of schools across Sub Sahara Africa, of which over 91 percent are primary and secondary school learners.

In a short time, COVID-19 has disrupted the landscape of learning in Sub Sahara Africa by limiting how students can access learning across the country. However, apart from the pharmaceutical interventions, other preventive measures like using of facemask, washing of hands, social distancing has been seen to be most effective ways of minimising the spread of COVID-19. The effective implementation of social distancing demands that schools be closed for as long as each government from different countries are certain that the pandemic has been curtailed enough for the safety of learners and teachers before resuming to classes.

2.2 Empirical Review

Ngogi & Mahaye (2020) argued that long periods of learning would be lost for as long as the closures lasted. This is evident as different cases are recorded daily. Kekić et al. (2016) reported that schools losing long periods of learning because of the disease outbreak could upshot to both chronological and stable smash up on educational system. The temporal damage includes disruption of curriculum which could take a long time to be recovered, while the undeviating spoil which include the actuality that some students may never come anymore to school even when the infection outbreak ended. This view cannot be truer than in Nigeria, especially in southwestern Nigeria, the study area, where most parents are struggling to send their children and wards to school, such that a little huddle will mark the end of education for such children.

Digital Global Overview Report (2020) opined that about 60 % of people from Nigeria are not associated to the internet. The data for mobile phones, which could also be used as a learning intermediary, are more hopeful. According to the report, around 169.2 million people, representing 83% of Nigerians have right of entry to mobile phone connections. However, of this figure, 50 %, (which is around 84.5 million people), live in municipal areas. For the populace with access, the quantity would be twisted towards elevated socio-economic households and urban households; an awe-inspiring preponderance of whom are private school students who already have a learning benefit over their public-school peers. For children from poorer backgrounds who tend to have less access to internet connectivity, computers, and other devices, and reside in rural areas where local languages take dominance over English, ICT-learning uptake will be limited.

3. Methodology

This article essentially adopted the secondary source approach to data collection. Consequently, the bulk of data utilised for the study were sourced from published articles, books, and internet and analysed by descriptive and content analysis.

4. Data Analysis and Discussion on Findings

At the institutional level, a number of Universities are offering data bundles to their students and staff. Going digital effectively requires substantial coordination with, and swift support from, institutional and national service providers, regional entities, international partners, NGOs, the private sector and ICT providers to rally behind such tools and platforms at little or no cost. It is imperative to seriously seek alternative means and approaches in order not to leave behind students with little or no access to electronic communication. The digital divide across southwestern Nigeria, the study area, has to be strategically and systematically managed. Reaching out to millions of 'marginalised' students must become a thing of urgent priority in this time of crisis. While this is taking shape, institutions need to develop a comprehensive plan and a rigorous follow-up scheme to ensure that academics and students make proper use of digital platforms. This task cannot be left solely to the discretion of individual actors.

It is however a misleading concept to reason that online learning could be effective by just posting a lecturer's notes online or having a video recording of the lecture. So far, this is what is generally happening at hand. Knowledge has revealed that eminent online learning need that the teaching materials are prepared by specialized instructional designers, which the lecturers are instructionally trained for bringing the program, and the students are equally uncovered to the instruction of online learning.

The gullible online freedom will have a contact on the value of the programmes. This is ill-fated at a time when key deeds have been made in improving the dominance of teaching and learning in advanced educational institutions in the study area. The programs that will most horribly be affected by the security lockdowns will be science and technology. This is because; students will not have access to laboratories for their practicals. Thus far, science and technology programs are the ones that are most vital for the nation's growth and development. The questions that would probably agitate our minds in this study may be: how can higher educational institutions (polytechnics and universities in particular) in the study area find choice to proceed to use laboratories and subsequently, how can they weaken the outlay of poor-quality programmes as a result of unplanned online freedom? Diversified means of educational delivery, in particular a non-residential model may become more mainstream, more acceptable and more respectable. Secondary schools which feed students to higher education institutions have also been closed due to the covid-19 induced security lockdown. Already, it had been observed that with the high increase in enrolment in secondary schools, resulting from measures taken to improve access, the quality of students entering higher educational institutions had declined. The circumstances will be provoked with the closure of schools, and higher educational

institutions will have to devise ways and means to cater for a poorer quality of student intake, perhaps by running remedial courses in the first year.

Also, end-of-secondary school examinations are being cancelled. What approaches should higher educational institutions adopt in selecting their next troop of students if assessment results are not available? Here, a general advance covering the whole education sector needs to be adopted.

5. Conclusion

The halt in business activities in the country as a result of the pandemic has rendered many penniless and unable to provide for themselves the basic amenities needed for the duration of the lockdown brought about as a result of COVID-19. The school system was affected by the lockdown and has resulted in disruption in the school calendar for schools and colleges in the southwestern Nigeria and the world in general.

Consequently, the article concluded that, an effective e-learning method that is backed up with workable policies, may rectify this imbalance in the educational sector in the study area and the country in general.

6. Recommendations

To mitigate the effect of security lockdowns and the covid-19 pandemic in general on education and the continuity of learning for students in southwestern Nigeria,

1. Ministries of Education in the area should mount up campaign to adopt distance learning mode through radio lessons in FM radio stations and TV lessons in TV stations.
2. Students who live in remote villages should arrange and move to nearest big town where there is connectivity, download the lecture and learning materials, assignments and examinations questions and go back to their villages to work on them and submit them via the same medium or other pre-arranged media.
3. Consequently, attitudinal change is important from all stakeholders. Already many universities give official email addresses and also form WhatsApp groups for students. Such media can be used as alternatives to send materials and examination questions to students. This could be a viable option.
4. The various unions and associations at the tertiary institutions should support their managements and students in this regard.
5. High quality educators have been compelled by current circumstances to use digital tools efficiently to deliver their courses.
6. Reaching out to millions of 'marginalised' students must become a thing of urgent priority in this time of crisis.
7. Educators should join online professional learning communities to pursue in-service career training to stay in touch with the trends, share tips and best practices to achieve the goal of an evolved and high-quality standard of education.
8. Instructors could invite colleague educators from another university to deliver a guest lecture to their students.

9. In order to make education more meaningful to all students, education should be made more accessible and less expensive. Education should be a right and not a privilege.
10. There should be deliberate policy of government especially by states within the area covered in this study, to see to it that the curriculum are harmonized to suit the present reality.

References

- Adotey, S.K. (2020). What will higher education in Africa look like after COVID-19? World Education Forum <https://www.weforum.org/agenda/2020/06/higher-education-africa-covid19-coronavirusdigital-online/> Africa News. (2020). Retrieved from <https://www.africanews.com/2020/06/17/coronavirus-in-africabreakdown-of-infected-virus-free-countries/> Accessed on 17th June, 2020.
- Azzi-Huck, K., and Shmis, T. (2020) *Managing the impact of COVID-19 on education systems around the world: How countries are preparing, coping, and planning for recovery*. Elsevier, 2(4), 3-8.
- Bester, G., and Brand, L., (2013). The effect of technology on learner attention and achievement in the classroom. *South African Journal of Education*, 33(2), 1-15.
- Brooks, F. (2014). *The link between pupil health and wellbeing and attainment*. Public Health England, Wellington House, 133-155 Waterloo Road, London SE1 8UG Tel: 020 76548000 www.gov.uk/phe.
- Denscombe, M. (2008). Communities of Practice: A research paradigm for the mixed methods approach. *Journal of Mixed Methods Research*, 2(3), 270 – 283.
- Digital Trend. (2020). Every single stat you need to know about the internet”, Retrieved from <https://thenextweb.com/podium/2020/01/30/digital-trends--2020-every-single-stat-you-need-to-know-the-internet> Accessed on 14th June 2020.
- Du Plessis, P. (2014). Problems and complexities in rural schools: Challenges of education and social development. *Mediterranean Journal of Social Sciences*, 5(20), 1109-1117.
- Du Plessis, P., and Mestry, R. (2019). Teachers for rural schools – A challenge for South Africa. *South African Journal of Education*. 39, 1–8.
- Dzansi, D.Y. and Amedzo, K. (2014). Integrating ICT into rural South African schools: Possible solutions for challenges. *International Journal of Educational Science*, 6(2), 341 – 348.
- Dziuban, C., Graham, C. R., Moskal, P., Norberg, A., and Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, 15(3), 2-7. Retrieved from <http://doi.org/10.1186/s41239-017-0087-5>.
- Dziuban, C., Graham, C.R., Moskal, P., Norberg, A., and Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, 1, 15-18. Retrieved from <http://doi.org/10.1186/s41239-017-0087-5> Accessed on 10th June 2020.
- Education International News. (2020). COVID-19 tracker, Published 25/03/2020. Accessed online (18/4/2020), From: <https://www.ei-ie.org/en/detail/16669/education-international-covid19-tracker>.
- Fowler, J.H., Hill, J.S., Levin, R., and Obradovich, N. (2020). The Effect of Stay-at-Home Orders on COVID-19 Infections in the United States. Unpublished.

- 10.110/2020.04.13.2..63628. Garrison, D. R., and Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, 7(2), 95-105.
<http://dx.doi.org/10.1016/j.iheduc.2004.02.001>
- Graham, C.R. (2007) *Blended learning systems: Definition, current trends and future directions*. Handbook of blended learning: Global Perspective, local designs. San Francisco, CA: Pfeiffer Publishing. pp. 3-21.
- Hatsu, S., and Asamoah, E.S. (2020). Online teaching, learning and assessment: A primer for tertiary education in Ghana.<https://www.myjoyonline.com/opinion/online-teaching-learning-andassessment-a-primer-for-tertiary-education-in-ghana/>
- Hrastinski, S. (2019). *What do we mean by blended learning?* *Technology Trends* Washington, 63(5), 564-569.
- Kathmandu, K. (2020). COVID-19 educational disruption and response: Continuation of radio education for secondary level students in Nepal. UNESCO.
<https://en.unesco.org/news/covid-19-educational-disruption-and-response-continuation-radio-education-secondary-level>
- Kekić, D., and Miladinović, S. (2016). Functioning of educational system during an outbreak of acute infectious diseases. Retrieved from:
<https://www.researchgate.net/publication/309728224>.
- Khan, A. I., Shaik, M. S., Ali, A. M., and Bebi, C. V. (2012). Study of blended learning process in education Context. *International Journal of Modern Education and Computer Science (IJMECS)*, 4(9), 20-23.
- Kuwonu, F. (2020). Radio Lessons: In Africa, schools are closed but learning goes on.<https://www.un.org/africarenewal/magazine/may-2020/coronavirus/africa-schools-are-closed-learning-goes>
- Mba, J.C. (2020). Challenges and Prospects for Africa's Higher Education. Association of African Universities.<https://www.globalpartnership.org/blog/challenges-and-prospects-africas-higher-education>
- Mirriahi, N., Alonzo, D., and Fox, B. (2015). A blended learning framework for curriculum design and professional development. *Research in Learning Technology*, 2, 18-23.
- Ngogi, E.M. (2020). *The Impact of Covid-19 Pandemic on Education: Navigating Forward the Pedagogy of Blended Learning*. University of Pretoria, South Africa, 5, 4-9.
- Nnabuike E.K., Aneke M.C., and Otegbulu R.I. (2016). Curriculum implementation and the teacher: issues, challenges and the way forward. *International Journal in Commerce, IT & Social Sciences*, 3(6), 41 – 48.
- Onwusuru, M.I., and Ogwo, B.A. (2019). Cloud-based portal for professional development of technology educators in Nigeria and the emerging virtual workplace. *International Journal of Arts and Technology Education*, 11(01), 1 – 17.
- Policy Brief: Impact of COVID-19 in Africa (2020).Retrieved from
<https://drive.google.com/file/d/17JYRwXNgsZ3PUInzcF2o3RNLkUEm5qts/view?usp=drivesdk> Accessed on 16th June 2020
- Pridmore, P. (2007). The impact of health on education access and achievement – A crossnational review of the research evidence. CREATE Pathways to Access Research Monograph No 2. Brighton: University of Sussex.
- Siemens, G., Gašević, D., and Dawson, S. (2015). Preparing for the digital university: A review of the history and current state of distance, blended, and online

- learning. Retrieved from <http://linkresearchlab.org/PreparingDigitalUniversity.pdf>. The Head of Education Committee (HEDCOM). (2020). South Africa. Framework for a Curriculum recovery plan – post COVID-19. 11 April 2020.
- Thelma, O., and Adedeji, Adeniran. (2020). Covid-19: Impending Situation Threatens to Deepen Nigeria's Education Crisis, Retrieved from <http://cseafrika.org/covid-19-risk-control-measures-threatens-to-deepen-nigerians> Accessed on 12th June 2020. UNESCO. (2020a). COVID-19: a global crisis for teaching and learning. <https://en.unesco.org/news/startling-digital-divides-distance-learning-emerge> UNESCO. (2020b). Monitoring COVID-19 caused by school and University closure. <https://en.unesco.org/covid19/educationresponse>
- United Nations Education Scientific and Cultural Organization. (2020). COVID-19 Educational Disruption and Response. Retrieved from: <https://en.unesco.org/covid19/educationresponse> United Nations Education Scientific and Cultural Organisation. (2020). Covid-19 Education Disruption and Response. Retrieved from <https://en.unesco.org/covid-19/educationresponse> Accessed on 10th June 2020.
- Viner, R.M., Russell, S.J., Croker, H., Packer, J., Ward, J., Stansfield, C., Mytton, O., Bonell, C., and Booy, R. (2020). School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review. *Lancet Child Adolescent Health*, 4, 397–404
- Wikramanayake, G. (2014). Impact of Digital Technology on Education. Retrieved from: <https://www.researchgate.net/publication/216361364>.
- World Bank Blog (18 March 2020); Retrieved from: <https://blogs.worldbank.org/education/managing-impact-covid-19-education-systems-around-world-how-countries-are-preparing>
- World Economic Forum (WEF). (2020). COVID-19's staggering impact on global education; Global Agenda. Accessed Online (18/04/2020), From: <https://www.weforum.org/agenda/2020/03/infographic-covid19-coronavirus-impact-global-education-health-schools/>.
- Worldometer. (2020). <https://www.worldometers.info/coronavirus/#countries>
- Zhong, B.L., Luo, W., Li, H.M., Zhang, Q.Q., Liu, X.G., and Li, W.T. (2020). Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *International Journal of Biological Science*, 16(10), 1745-1752. Zhong, B.L., Luo, W., Li, H.M.,
- Zhang, Q.Q., Liu, X.G., and Li, W.T. (2020). Knowledge, Attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey. *International Journal of Biological Science*, 16(10), 1745-1752.

ORGANIZATIONAL STRUCTURE IN THE POLYTECHNICS: YABA COLLEGE OF TECHNOLOGY, A TEST CASE!

Otunba Peter S. Adekanla
CPA, AMC, FNIM, AIPM
Villanova Polytechnic Imesi-Ile
Peteradekanla@gmail.com

ABSTRACT

The Paper covers organizational structures which apply to almost all tertiary institutions at all levels in Nigeria, except few peculiarities in some institutions, both in Government and Private, universities, polytechnics and colleges of education. However, I use Yaba College of Technology, where I did all my service years and retired, as a Test Case. It explains, organogram, structures level by level, for example, Governing Council, Academic Board, Management, School Board, Department Board and the Congregation. It also covers principal officers' positions, the Rector, Deputy Rector, Registrar, Librarian and the Bursar. For ease of management, channels of communication are also covered while the dichotomy, in title, among the chief executives of university, polytechnic and college of education is also treated.

1. Preamble

There are different types of Organizational structures depending on the type of Job the Organization is performing: - educational, Productive, Industrial, Civil Service etc. In the Educational Sector, be University, Polytechnic, College of Education, the structure is almost the same. You just exchange Vice Chancellor for Rector in the University and Polytechnic while Provost in the College of Education, Senate for the University and Academic Board for the Polytechnics. Both in the university and polytechnics, Vice Chancellor and Rector are the Chief Academic officers respectively while the Registrar is the Chief Administrative officer and the former two are the Accounting officers respectively.

In short, Organizational Structure, in any Organization, is simply "Hierarchy of Authority," that is, splitting of authority to perform from the highest position down the ladder to the grassroot. However, for the sake of this paper, I seek permission to lay more emphasis on the structure of Polytechnics, especially, Yaba College of Technology, the pioneer Tertiary Institution in Nigeria, the first set of which students formed the nucleus (first) set of the University of Ibadan in 1948¹.

2. The Governing Council

The council is the governing body of the college whose scope of activities covers the general management of the affairs of the college through formulation of policies, and in particular, the control of the property and the finances of the college. It is also within its power to do anything which in its opinion is calculated to facilitate the carrying out of the activities of the college and promote its best interests.

It is the responsibility of the council to appoint all the senior Academic and Administrative staff of the college, including particularly, the Rector, Deputy Rector,

Registrar, Director of schools and Heads of Departments, and also to discipline any of them if the need arises.

The council is the highest Authority in the college, as well as the employer of all the college staff, both Senior and Junior.

3. Governing Structure

For the efficient and effective management of each Polytechnic, the following bodies are put in place:-

a) Governing Council

This body is the employer of all staff both senior and junior, academic and administrative, permanent and casual. It is also responsible for the formulation of general policies for the polytechnic on administration and finance. Appointment of members is done by the Government.

b) Academic Board

A body responsible for all policies and management of academic matters – courses, examinations, graduations, award of diplomas etc. Appointment of members by Council via recommendation by Management.

c) Management Committee

The body is administrative, to assist the administration of the Chief Executive. The body is made up of Principal officers – Rector (Chairman), Deputy Rector, Registrar, Bursar and Librarian, to meet once a month.

d) School Board

An academic body for each school, made up of all academic staff in the school with the Dean as chairman. It deals with all academic matters and any other matter of interest to the School or any other matter referred to it by Council or Rector.

e) Departmental Board

An academic body for each Department consisting of all the academic staff in the Department to handle all academic matters of the Department. The Head of Department is the Chairman.

f) Congregation

This body is made up of all academic staff and senior non-teaching staff. The Rector is the Chairman, to meet at least, once in a year.

g) In addition to the above bodies/committees, there are still some administrative committees to assist in the management of the Polytechnic – Selection Board – A&PC, Student Disciplinary Committee, Students Welfare Committee, Tenders Board, Staff Welfare Committee etc

4. Positions of Principal Officers

i. The Rector

The Rector is the chief academic officer, as well as being the accounting officer of the college. He is also the chairman of the Academic Board, Management Board and Congregation. It is the sole responsibility of the Academic Board to approve the students Results at the end of each Academic Semester.

By the virtue of Decree establishing the college, he is empowered to exercise general authority over the staff, and he is responsible for the discipline in the college.

While the appointment of the senior academic and administrative staff is the prerogative of council, that of the junior staff is that of the Rector with the assistance of such committees as may be constituted by him for such purposes.

ii. The Deputy Rector

To assist the Rector and acts in his absence.

iii. The Registrar

The Registrar, as the Chief Administrative officer, is responsible to the Rector for the day to day administration of the College. He is the Secretary to the Governing Council as well as the Academic Board and Management Committees.

Beside his other administrative commitments, the Registrar prepares Council papers and communicates council decisions to relevant quarters. He also serves as an adviser to the Rector on staff discipline and other relevant issues.

iv. Bursar

He is the chief financial officer

v. Librarian

He is in charge of the library for acquiring relevant books and administering library services. They are all responsible to the Rector.

Note With the Federal Polytechnics (Amendment) Act 2019 in operation, all the principal officers are to enjoy only One tenure of Five years in office while criteria for their appointments and creation of Council and its committees are also spelt out respectively.

5. Hierarchy of Authority

According to Professor O'Donnell in his article on the source of authority, "If a directive communication is accepted by one to whom it is addressed, its authority for him is confirmed or established.

It is therefore admitted as the basis of action. Disobedience of such a directive communication is a denial of its authority for him. Therefore, under this definition, the decision as to whether an order has authority or not lies with the person to whom it is addressed, and does not reside in 'persons of authority' or those who issue these orders."

The highest Authority within the periphery of a Polytechnic is the Governing Council, a body corporate, responsible for the general management of the affairs of the college by formulating necessary policies and giving directives. The policies and directives are passed down to the Administration through the Rector who is the Chief Academic Officer, as well as being the accounting officer of the college. The next officer in rank to the Rector is the Deputy Rector, a position which is made rotatory among the Directors/Deans of Schools. The position of the Vice Rector is not permanent but rotatory, and becomes functional only when the incumbent stands in for the Rector in his absence. As at now, the tenure is 4 years.

Council policies and directives, as the case may be, are transmitted through the Rector to the Directors of Schools, and from them, to Heads of Departments and then down to the Heads of sections.

In effect, the hierarchy is in line with scalar structure whereby Heads of sections are directly responsible to heads of Departments, Heads of Departments are responsible to Directors of Schools, who in turn, are responsible to the Rector for their day-to-day official performance.

The Rector is accountable to the Governing Council of the School.

6. Channels of communication

The channels of communication available in the Polytechnic system are downward, upward, lateral and multidirectional.

Downward channel of communication is employed when directives, job instructions and rationale are passed from the School higher Management to the subordinate staff. Such communication passes through the different levels of authority down to the floor man.

Upward channel of communication is employed when a feedback is being given by the staff to the authority or in case there is an observation on such directives. An upward channel of communication is also used by staff to air their views and grievances (workers' Union/ students body in particular) to the authority.

Lateral channel of communication is used among the Directors of Schools, Heads of departments or Heads of sections. For example, if a particular Director of school is short of staff, it is his duty to communicate such requirement to the Registrar who would make arrangement to hire the right caliber of staff for him with the approval of the Rector. On hiring the staff, it is the duty of the Registrar to advise the Bursar to put such staff on the college payroll. Also, if a staff from any of the Departments falls sick, it is the duty of the Head of Department concerned to communicate with the Director of Medical Services to give such a staff necessary treatment.

The same thing occurs in the case of multidirectional channel of communication.

The four different channels of communication are shown below.⁵

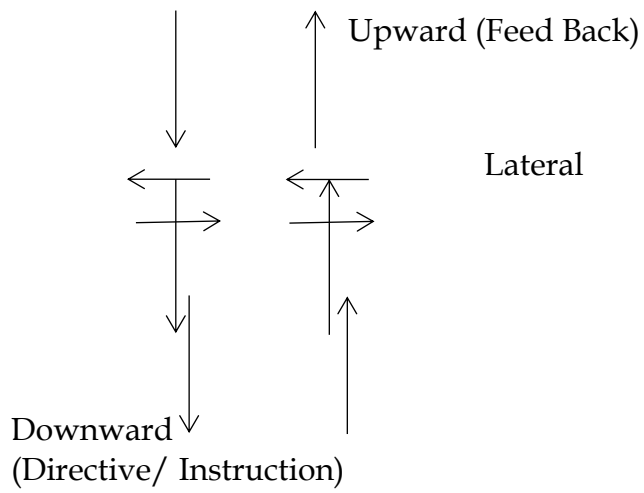


Fig. 1

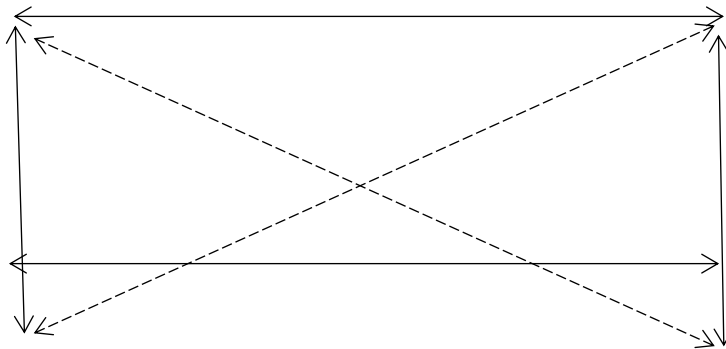
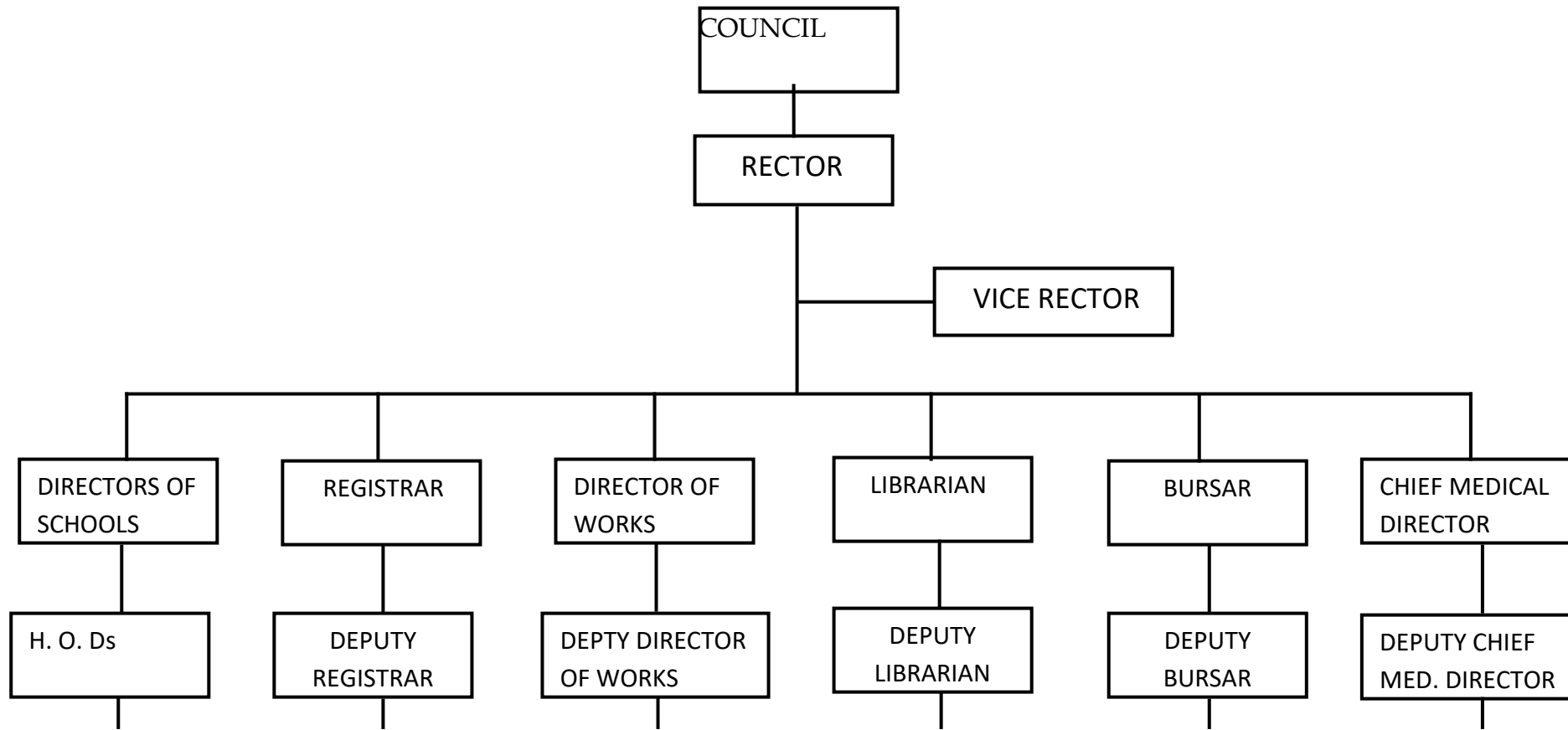


Fig.2 Multi-directional

YABA COLLEGE OF TECHNOLOGY

ORGANISATIONAL STRUCTURE



N.B.

-

H.O.Ds - Heads of Departments

H.O.Ss - Heads of Sections

P.A.R - Principal Asst. Registrar

P.M.O – Principal Medical Officer

Fig 3

BIBLIOGRAPHY

1. Elliot Commission Report – Higher Education in West Africa (1947)
2. Federal Polytechnics (Amendment) Act 2019
3. 2Cyril J. O'Donnell, "The source of managerial Authority",
Political Science
Quarterly, Vol. XLVII Dec.1952, pp.573-88
4. 3Chruden/ Sherman, personnel management,
(south- western publishing co.5th Edn), p.61
5. 4Ibid., p.291

IMPACT OF ICT ON THE EFFECTIVE TEACHING IN SELECTED SECONDARY SCHOOLS IN AKOKO NORTH LOCAL GOVERNMENT AREA OF ONDO STATE.

Asanbe M.O

Department of Computer Science
Villanova Polytechnic, Imesi-Ile
Osun State, Nigeria
moasanbe@gmail.com

Olagunju M.P

Department of Computer Science
Villanova Polytechnic, Imesi-Ile
Osun State, Nigeria
maryponle@gmail.com

Abstract

ICT is an acronym for Information and Communication Technology. In the teaching-learning process, the child has emerged at the center of learning experiences. His life is full of experiences and actions. His senses of seeing, hearing, touching, smelling and tasting form the basis for understanding the environment. It is in this light that Information and Communication Technology (ICT) becomes, very imperative as a companion in the learning process. One of the greatest challenges in ICT use in Education is balancing educational goals with the economic realities. ICT in education programmes requires large capital investments and developing countries need to be prudent in making decisions about what models of ICT use will be introduced so as to consciously maintain economies of scale. This study is carried out to examine the adequate, constructions, effectiveness, facilities and other ICT tools in Akoko North East Local Government Area of Ondo State. The study is limited to both secondary school teachers and students from 10 selected schools, because of time constraints and limited resources. The researchers considered ten (10) secondary schools' teachers and one hundred (100) students both male and female. Equal number of respondents – teachers and students alike were randomly selected from the ten (10) schools. The instrument for this study is a questionnaire: two sets structured questionnaire were administered by the researchers. The study would assist the curriculum planners, parents, government, educators and individuals interested in different subjects teaching in relation to ICT in Nigeria at secondary school.

Keywords: ICT, Education, Learning, Communication, Technology

Introduction

In Nigeria secondary school today, the teaching and learning of computer is important in the policy of education. In early days of computer technology in Nigeria only professionals and students who primarily studied computer science or related courses

could interact with computer system. Now, there is rapid growth and wide use of computer system in virtually all fields of studies such as arts, medicine, law, social science, engineering, technology and education.

Computer which is an electronics device that accepts data as input, processes the data and gives out information as result or output has penetrated every life of human endeavour for the fact that computer is designed to do the following things receive data, process data and give out information. It was revealed in April 2000 by the National Centre for Education Statistics that, between 1996 and 1999 computer and mobile phone have become part of everyday life in Finland. The numbers of students who use computer everyday has grown up, especially among secondary school students. Since the world is a global village, Nigeria cannot afford to ignore the role which computer literacy plays in achieving the national goal of technological development.

Computer is now being offered at the secondary school level of education in Nigeria as one of the science subjects. The subject is meant to acquaint students with the basic skills and knowledge of computer that will fit them directly into the world of work. The National Commission for Computer Education (NCCSE) 1988 outlines the following as the objectives of teaching computer studies at the secondary school (Pg 8 - 12)

- Ability to use and program computers
- Knowledge about the history of computers
- Appreciation of the economic, social and psychological impact of the computer
- the use of computer in problem solving

In spite of this, the performance of students coupled with their attitude to the subject has not been encouraging. Several measures have been recommended to enhance students academic performance in secondary school subjects. Among the measures recommended are appropriate use of teaching methods, electronic media, instructional media and resources.

The reason for using instructional media in the school system is to transmit information in the teaching and learning setting. This is because they are materials that enhance or facilitate effectiveness in the teaching and learning process. Instructional media according to Schramm (1999) is referred to as a basic channel for communication in the class room for the purpose of bringing about effective teaching and learning. That is, instructional media are those materials or objects that help the teacher in making the lesson more interesting to the learners.

It has been observed that using instructional or educational media in teaching and learning make students learn more and retain better what they have been taught and that is also promotes and sustains students interests. It also allows the learners to discover themselves and their abilities. It enriches learner's knowledge and reinforces verbal instruction. In other words, when instructional media is used, there is tendency to make classroom environment lively and interesting.

There are different types of instructional or educational media, depending on what to teach, where to teach and availability of instructional media in that environment.

According to Abimbade (1997), instructional media can be classified into three categories: these are non print media, print media and electronic media.

The printed materials are books, text, maps, journals, while non-print media are projected materials such as films, slides, film strips and electronic media consist of visual, audio and audio visual that relies on electricity to function effectively. All these and more stimulate a sense of observation in learners.

The issue of gender in education has been a recurring decimal in research. As indicated in the Nigeria blue prints on women education (1977 – 1981) several factors affect, female participation in technology. That is, female students often run away from science and technological subjects because of the social pressure and potential altitude of female role models. This tendency has been noticed from secondary schools. Both girls and boys feel that teacher, counselor and parents perceive science subject especially technology as male oriented field course. This perception encourages boys than girls to have flair for technology education no wonder then that inmost organization male are often seen as the head of the computer or information technology section while the female counterparts are somehow found acting as data entry personnel. Shashasi (1993) observed that females are less interested in computer and less confident in the operation of computer than males.

Studies have shown the facilitative roles of instructional media in learning, but most of these studies are in other school subjects apart from computer studies. Being a relatively new subject in the curriculum of Nigerian secondary schools, not much had been reported about the effectiveness of media in its teaching and learning. Also, most teachers assure that computer science does not require any other illustrative device apart from computer itself. The need to verify thus notion partly informs this study.

The research work sought to provide solution to the following and other questions relating to teaching of computer studies by making use of instructional /educational media in some selected secondary schools in Akure South local government.

- How many of the selected schools offer computer studies?
- How many computer teachers are in the school?
- How many period(s) do they have in a week?
- Do the computer teachers teach other subject than computer?
- Do they make use of any instructional media for the teaching of computer?
- How many computers do they have?
- Do they have enough textbooks for students?

Review of Related Literature

Psychologists, Educators and scholars have carried out investigative studies on the role and effect of instructional media on the learning and teaching of computer. These different set of investigators and writers have concerned themselves with genuine effort to identify the need in the teaching and learning of computer.

To simplify and fully comprehend the issue under instigation, it will be of great help and significance to ask these questions: What is teaching? How do you explain that teaching is effective? What is learning? What are instructional media? Why is it important to teach computer by using instructional media?

Teaching

Teaching has been defined long time ago in the traditional way of teaching before the modern system come into existence. The traditional way of defining teaching was highlighted by Osundiran (2000). The aims and activities were concerned to be temporary ability to recite school books, facts, understood partially or not at all and unrelated to the problems and needs of either young people or adult. It is very clear that reciting textbooks, facts and the other written documents cannot lead to learning by a part of it.

Any teaching that does not lead to permanent change in the behaviour is not completed. A modern teacher teaches so as to understand and see with their naked eyes. Mill was trying to point out systematically the importance of instructional material during teaching and learning process.

Oyekan (2000) describes teaching as a set of conscious and deliberate actions intended to induce learning by impacting desirable knowledge, skill and attitudes. It should be a morally desirable and socially acceptable activity whose end result or goal learning in achieving meaningful and logical sequenced learning demand adoption of behaviour objectives because they emphasize the behaviour students should demonstrate by the end of the lesson.

Olasunkanmi (2004) says that teaching appear to be quiet a complex concept. It is body of actions intended to induce learning. He further defines teaching as the “conscious and deliberate effort by a matured or experiences person to impact knowledge, information, skills, attitudes, beliefs e.t.c to immature or less experienced person with the intention that the latter (the immature or less experience person) will learn or believe what he is taught on a rational basic”. One criterion that can be identified from the definition is that there is the assumption that in the process of teaching, a person is consciously and deliberately doing the teaching.

Teaching also connotes a lot of other meaning if used without clarification. It could refer to human action. It involves relationship based on interaction. This interaction is linked to what happens in communication is linked to what happens in communication system whereby we have at one end the sender to the information and at the other the receiver. In the teaching process, the receiver is the one being taught. This referred to in the definition “the immature or less experienced person”. This implies that a learner is logically necessary in the act of teaching. It will not make sense if someone says he is teaching computer to nobody, for except and until the person at the other end receives the information, the teacher has not performed the act of teaching.

The definition also gives a third criterion that of impacting knowledge, information skills, attitudes, beliefs e.t.c. In simple terms, this implies that some content or material in the form of information, knowledge e.t.c is being impacted. It then logically follows that; there must be something to impact in the act of teaching. Teaching therefore only occurs when there is content i.e, something being taught.

The fourth criterion is that there is at least an intention on the part of the person doing the act that the recipient should learn. Teaching involves sharing of the meaning of the subject matter by the teacher and the students.

Finally, we must take note of the fact that the teaching method must be morally sound and accepted. This means that the learner should willingly to learn while he is being taught.

Olasunkunmi (2004) explains that the process of teaching can be divided into four steps. The first step is the presentation. This happens when the teacher presents the subject matter to the students. The subject matter could be information, skills, attitudes, beliefs, etc. the second step is the examination of the information by the students and asking of questions from the teacher. This makes teaching involve rational explanation and critical dialogue. The person who teachers must acknowledge the right of the students to ask questions, to call his judgment to question and to ask for justification of his statements. The third step involves the negotiation of the subject matter by the student and the teacher. This step involves clarification of idea and facts and voluntary acceptance of such facts and ideas. The fourth step involves the sharing of the meaning of the subject matter. This stage is what implies teaching as an achievement.

The Concept of Learning

Over the ages, educationist and psychologist have been known to devote considerable time to what constitutes learning by searching into it and also how to improve it. As a result, several definitions of learning have emerged.

Some defined learning as a change in human behaviour or disposition arising from experience which persists over a period of time and which is not simply ascribable to processes of growth. Learning has also been seen as a sum of the changes which occur in an individual stemming from his responses of representative stimuli, present or past or based on interaction. Learning therefore may lead to attitude formation, perceptions, preference and interests.

According to Okoye (2000), if we regard learning as a relatively permanent change in behaviour arising from experience, then the following words may be regarded as key words before it can take place; permanent, change in behaviour, and experience, learning can hardly take place, it follows therefore that learning can be perceived as a process which involves the learners and what he set to learn and a change in behaviour in order to solve a problem arising from his situational environment. However, not all situations involving change in behaviour can be classified as learning situations. It has been shown that some plants and animals respond to illumination negatively or positively through

instincts rather than learning. Irritation in both plants and animals has been provided to be instinctive rather than learning.

Oyekun (2000), learning is a gradual change in behaviour which ought to be frequently practiced and reinforced to prevent its extinction. It is a sort of biological adaptation as it occurs when the students adjust to cope with the conditions of educational environment and dynamic society. Achieving meaning and logically sequenced learning demands adoption of behavioural objectives because they emphasize the worth while behaviour students should demonstrate with proficiency by the end of the lesson. Hence learning must be based on familiar internalized activities while the resulting curiosity and determination can be surprising achievement in the children. Greater students conceptual understanding can be enhanced when teaching is oriented towards the state of operational readiness of the students as well as the use of local examples and concrete objects that produce first hand experiences which appeal to human senses. The varied opportunities to learn by doing, through active participation in a conducive environment shall promote good teaching and make the students happy with better performance at school.

Nuke (1998), learning is a relatively permanent change in behaviour as a result of practice or experience: "the man who ceases to learn soon ceases to live" and "the teacher who ceases to learn soon loses the opportunity to teach". These statements underline the importance of the learning process in life. We live in changing society and for us to survive and live happily, we need to adjust or adapt to our environment. This we can achieve by acquiring habits or ways of behaving. We are continually engaged in our learning activity on another throughout life. By observing the change in behaviour patterns in people we know that learning has taken place.

Definition of Instructional/Educational Media

Education cannot take place without one form of communication or the other. Communication involves the process of sending and receiving information or message. For messages to get transmitted they must pass through a channel or medium transmitter. Thus, media are channels through which messages, information, ideas and knowledge are conveyed and or disseminated. When such media are used for education or instructional purposes, they are called educational or instructional media.

Medium (or media in plural) is used in general to mean a means of communication. It refers to anything that carries information between a source and a receiver. Instructional or educational media are means of communication used to carry messages with an instructional intent.

According to Abimbola (1997) educational or instructional media are a broad – range of resources which can be used to facilitate effective and efficient communication in the teaching-learning process. Though, instructional media can be seen as generic term but in terms of functionality it is non ambiguous. For examples, educators can readily recognize such instructional materials as audio-visuals, electronic, print or non-print,

projected or non-projected aids and other forms of telecommunication gadgetry-radio, television, video tape recorder etc.

Cahnham and Ozigi (1978) describe instructional materials as "Aids that help the learners by sources or by sight" he also emphasized that these materials are not for the teachers but they are to assist the students since they promote learning rather than teaching. According to them, the best instructional materials are concrete objects itself. However, since these cannot always be taken to the classroom he suggested that teachers should make use of temporary and permanent materials as well as display.

Ogunlade (1988) refers to instructional media as "equipment or materials intended to make better teaching more complete learning, these equipment and materials provide the learners with multi-sensory impression that make it easier for him or her to remember what he has been taught such media can be regarded as device through which learning process may be encouraged and motivated under classroom situation.

Romiszowski (1971:176) viewed instructional media as "something that assist the teaching of a topic or subject matter".

Adewole (1968:98) defined instructional materials as "materials which the teacher uses in convey information, ideas, and messages the students"

Brown et al (1969) from his own point of view said that instructional materials "(from instructional technology) goes beyond any particular medium or device" in this sense instructional technology is more than the sum of its parts. It is a systematic way of designing carrying out and evaluating the process of learning and teaching in terms of objectives based upon research in human learning and communication and employing a combination of human and not human resources to bring out more effective instruction. According to Aroloye (1985) "Instructional materials has increase students, financial learning and reading". Interest helps to improve retention of learning stimulates activity, influence attitude, which they could as well as possible be said to be good for both slow and fast learners. Teaching and use of instructional materials in our schools today is due to lack of finance to acquire them.

Oladipo (1970) refers to instructional materials as "objects or things which are used in classroom for teaching to facilitate the understanding of the concepts to help children learn with ease and understanding.

Generally, the relevance of instructional media lies in the various levels of the learning materials and equipment.

Adeyemi (1981) and Ogili (2001) contend that the best strategy for effective communication in educational instructions is guaranteeing continual use of skills by the prospective learners in the production of prototype materials

Basic Consideration in Choosing Instructional Materials.

To embarking on any instructional materials in the teaching learning process, certain basic pedagogical consideration has to be put in place. Some of these according to Maduabum (1996) include:

- The objective of the lesson
- What is to be taught
- The background knowledge of the learner
- The durability of the instructional materials
- The cost advantage of the instructional materials.

Knowledge of the students' academic background would provide the learner with insight into whether instructional materials would be appropriate to learn the task at hand or not, for this reason it would not be very appropriate to provide students with an improved typewriter in teaching computer keyboard.

The Roles of Instructional Media in Teaching and Learning

- Instructional media provide concrete experience and enables students to integrate prior experiences with new learning. Psychologists, like Jerome Bruner have proposed that learning is facilitated when instruction follows a sequence from actual experience through iconic representations (as in pictures, films e.t.c), to symbolic representation (as in words). Through instructional media, the learner can visualize concepts that would otherwise have been abstract.
- Instructional media help to support teacher-based instruction educational media can serves as aid to teaching. This has been the key reason for using educational media. Teachers use them to support their teaching. They use them to introduce the lesson, to highlight points, to generate attention, to elicit responses. They use them as advance organizers" which serve to prepare the learners mind towards receiving instruction. David Ausubel, an educational psychologist developed the concept of "advance organizers".
- Instructional media can facilitate students drill and practice. For examples, audio tapes can be used effectively for drill and practice in spelling, mathematics and language instruction. The computer is also well suited for drill and practice exercises
- Instructional media can help promote the "discovery" or "inquiry" approach to learning and teaching. Recorded video, for example, can be used to stimulate creative learning activities.
- Instructional media can help take over some of the routine tasks of the teacher thereby enabling him to have more time for other important tasks, use of media enables the teacher to play the role of a facilitator or manager or learning rather than a dispenser of information. For examples audio cassettes with task directions, practice work books, computer, e.t.c can help free the teacher from routine exercise.

- Instructional media is particularly suited to individualized instruction. It can provide learners with materials that are specially designed or chosen to suit their individual needs, interests, abilities and experiences.
- Instructional media can help learner to concentrate their attention, time and effort on a learning task.
- Instructional media has taken instrument to non-formal setting outside the school. Learning and teaching now take place in homes, in business premises, in factories, in the market, everywhere and at any time. Instructional media has broken barriers to education physical (distance), environment, demographic or economic. It is therefore no wonder that distance education has relied heavily on instructional media.

Types of Instructional Media

There are different types of instructional media: The following will be considered:

- Non- projected materials, these are materials that do not required projection for viewing. They are not electronic. These include printed materials, pictures, diagrams, chart, posters.
- Projected and Audio Media: These are media that require power from electricity or other sources such as battery. They are projected or electronic media. Examples are Opaque projector, as well as audio tape/cassettes and radio.
- Multimedia system: it is a combination of two or more media. Examples are sound –slide, sound-film strip combinations, multimedia kits.
- Non-Projected media: These are instructional materials that do not required projection for viewing. They are not electronic. These include printed materials, pictures, diagrams, charts, posters, models, etc.
- Printed media: These include text books, factors tutor guides, journals, workbooks, handbooks, reference books, readers, magazines, periodicals newspapers, letters, booklets, bulletins, handout, etc. Printed materials are easy to use as they do not require any special technology. Learners have a high degree of control over where and how they choose. They can be used to teach most subjects effectively. They use words, numbers, illustrations, graphics, photographs, diagrams and sketches which aid learning.

Printed materials can be written for classroom use, for independent study and reference purposes.

- Non-projected visuals: These are visuals that do not require projection for viewing. They are readily available and are used more extensively in the classroom. This is

particularly true of developing countries where lack of electricity, poor funding, lack of know how limits the use of projected and electronic media. These are classified under three classes: still pictures, graphics and realia

- Still Pictures: These are photograph like representations of people, places and things. They include photographs, illustrations (in books, magazines and newspapers), drawings and paintings. They are easy to use since they do not require any special technology. They help to “concretize” abstract ideas, still pictures can be used in a variety of ways.
 - i. to illustrate the lesson
 - ii. to record information
 - iii. to understand the write-up in the textbooks, newspapers and periodicals.
 - iv. To test and evaluate what has been learnt.
- Graphic material: This is the second category of non-projected visuals. It is called graphic materials or simply graphics. Graphics are non-photographic, two-dimensional materials that communicate information or ideas using some combination of drawing, words, symbols and pictures. Graphics messages are brief, well focused and visually symbolic rather than fully representational. Graphic materials are of various kinds namely drawing, charts, graphs, posters e.t.c
- Projected Electronic Media: Electronic media are instructional materials that require power from electricity or other sources such as battery. These are different types of electronic media which include;
 - (a) Overhead projectors: These are used to project transparencies. Transparencies may be composed of photographic type film, clear or made from cellophane. The projector can be used for both teaching and non-teaching situations. The user can face the audience or students in the case of classrooms or laboratories. He writes on the transparencies to project ideas. On the screen and at the same time maintains an eye contact on his audience. Overhead projector can focus course contents on classroom walls with very little room light as it does not require total darkness. This is particularly suitable for large group presentation. It enables the lesson to be developed progressively-by -step.
 - (b) Film Strip: can be described as a sequence of related still pictures imprinted on a transparent film. A strip usually has 15 – 45 or more films. The projectors for film strips are easily operated and they are inexpensive. Many topics on various subjects can be prepared and focused. The films are arranged sequentially for all topics and pictures can be focused one after another. They are well suited for independent study. The film strip viewer is useful for teaching a small class while the projector is useful for a normal classroom presentation. During a classroom

projection, the teacher presents the sequence step by step or frame by frame. He describes each frame before the next frame is advanced.

(c) Opaque projector: This is the projection of non-transparent (Opaque) projector. The opaque projector projects images from textbooks, newspapers, magazines, maps, illustrations, diagrams, photographs, specimens, objects, etc by reflecting light off the materials through a series of lenses on to the screen or white wall. Opaque projector permits group viewing and discussion of students work. it saves the teacher the time for drawing on the chalkboard or card board sheets as materials can be projected directly. It is very useful for very small groups or classroom size group that need to view the enlarged form of some printed or visual materials. It can be used in all curricular areas and at all levels.

(d) Television: is like the film except that it is electronically operated whereas the film is mechanically operated. Television and video share all the advantages of motion pictures and have an additional advantage of needing no operator.

Today the television has become not only a mass medium but also fast becoming an individual medium. It is becoming nearly as available as audio tapes and has become a rich resource for instruction and training.

There are educational television and instructional television programmes. Educational television is a broad term used to cover all television programmes aimed at education rather than entertaining the public. The target audience does not aim at passing any prescribed examination after listening to the programme. Instructional television on the other hand is any planned use of video programmes to meet specific instructional goals regardless of the source of the programmes.

- Computer

Computer which is an electronic machine that accepts data as input, processes the data and gives out information as the output, is another instructional material that aids teaching and learning process. The use of machine, computer programmed instructions have made it possible for learners to learn at their own pace.

Similarly, the learner is now at the centre of all the teaching-learning process and is reinforced immediately with immediate knowledge of result.

Broadly speaking computers have been applied in two main ways in education, as Computer Managed Instruction (CMI) and as Computer Assisted Instruction (CAI). Until Micro Computers entered schools, classroom computing resources usually were classified under three general headings

- Computer Assisted Instruction (CAI)
- Computer Managed Instruction (CMI) and others

CAI usually referred to drill-and-practice, tutorial and simulation software; CMI encompassed testing, record-keeping and reporting software. During the 1980s, other authors began using many more inclusive terms to refer to instructional uses of

computers such as Computer Based Instruction (CBI), Computer Based Learning (CBL) and Computer Assisted Learning (CAL)

Instructional Software Performs the Following Roles;

(a) Tutorials Activities: Here, the courseware teaches directly. It enables the students to learn the topic without any help or other materials from outside the courseware. It is self-contained. This kind of software will require the learner to be able to read and do independent study. Even with this courseware, the human teacher can still assist slow learners.

(b) Drill and practice activities: This software provides exercises on which students work examples, one at a time and receive feedback on their corrections. Drill and practice software can help save the teacher's time as students work on their own. The students can get immediate feedback. It can motivate students to do the practice.

(c) Simulations: These software modes real or imagined systems to show how those systems or similar ones work. Simulations give access to experiences which would otherwise be impossible. Simulation can show students what it would be like to walk on the moon or to build their own cities, create a budget for them, populate them and run them, including responding to intermittent disasters.

(d) Problem-solving courseware: They can teach directly, through explanation and /or practice the steps involved in solving problems or help learners acquire problem-solving skills. This software provides the students with the opportunities to solve problems. The problem-solving may be specific to teaching content area skills or focus on general, content -free skills.

Others Instructional Materials that Aid Teaching and Learning Process are:

- Bulletin Boards
- Magnetic Boards
- Audio Tape
- Video Tape Recorder etc.

Issues Associated with the Use of Instructional Materials in School

A number of issues are associated with the use of instructional materials in the learning -learning processes in schools and they include:

- Availability of instructional materials
- Awareness importance of instructional materials by teachers
- Funding instructional materials in schools

- Availability of trained personnel for handling instructional materials.
- Lack of in-service programmes for the teachers who use instructional materials.
- Maintenance of instructional materials.

Methodology

In this study, pre-post test, control group quasi-experimental design was used with one experimental group (instructional media treated) and one control group (without instructional media treatment)

Research Design

The study examined the effect of instructional media on the learning of computer studies in Junior Secondary School (A case study of Akure South Local Government Area).

The study took place at the school of the participants. The instructional intervention was divided into three phases; pre-testing, treatment and post-testing, treatments were carried out across five weeks and based on computer studies curriculum. Assessment methods were the same for all students who participated in the learning.

During the sessions, different experimental tasks were employed in order to evaluate the degree of achievement through the teaching and learning of computer studies using instructional media, without instructional media, effect of instructional materials on female students learning computer, differences of student taught computer in rural and urban areas, etc.

Research Instrument

Four instruments were prepared and used in this study, namely:

- Computer Studies Achievement Test (CSAT): This is a 50 multiple choice questions with four options per item. The questions covered selected concepts taught during the lesson. These include concepts of computers, types, classes, components of computer characteristics of computer, programming language (BASIC and LOGO)
- Operational Guide: This is a guide of instructions for the use of the teacher in the experimental and control group. The researcher drew the chart of types of computer on a transparent paper and projected it for the class in the experimental group.
- Instructional Media: This consists of media resources used in the treatment of the experiment group
- Questionnaire: The researcher also administered questionnaire to the student in selected secondary school students

Population of the Study

All the students in the Junior classes in Akure South Local Government Area of Ondo State constituted the population of the study.

Sample and Sampling Techniques

A total of 150 students purposively selected from five (5) secondary schools in Akure South Local Government Area participated in the study five schools were selected randomly from stratified schools that fall into the following criteria:

- Schools offering computer studies
- Schools having permanent computer teachers
- Schools having mini computer laboratories.

The JSS3 arms class was used in the study.

Validation of Instrument

The computer studies achievement test was given to expert in related field to help in establishing the face and content validity of the instruments. To establish its reliability, a test, re-test method was adopted. The instrument yielded a reliability co-efficient value of 0.75, the items analysis of the instrument was also conducted in order to determine the discrimination indices and difficulty level of the items.

Procedure for Data Collection

The procedure was in three phases: in phase one, the researcher drew the chart of computer system on transparent paper and projected it through a projector to show various components of the computer system, types and classes of computers as well as people working with computer to the class of the experimental group. The researcher then conducted training for teachers in the experimental and control groups. On how to use the operational guide of instruction, the teacher in the experimental group also made use of instructional media package prepared for the experimental group.

The first week of the experiment was used to conduct the pre-test in order to determine comparability of the group. The two groups were found to be comparable based on the mean pre-test score.

In the second phase, the students were taught computer studies using instructional media to explain some concepts in computer studies such as concept of computer, types classes, and components of computer, characteristics and some application and uses of computer to the experimental group while the control group was taught without instructional/media. This lasted for five weeks, while in the third phase, the computer studies achievement test was administered as a post-test for students in the experimental and control groups.

The questionnaires were also administered on the participants who consent was sought and returned back to the researcher.

Method of Data Analysis

In analyzing the data, the researcher adopted percentage for the analysis. The non-parametric statistics of chi-square were also used to test research hypothesis. Results of data analysis were tested at 0.05 level of significance.

Discussion of Findings

Data analysis in this study shows that facilities like computer systems, email accounts, Projectors, Public Address System (P.A.S), E-Library, printers for print out of learning materials by students and Social-Media Platforms are available for learning while ICT facilities like Internet Facilities, Computer training Centre for students on campus and Stored lecture notes on CD-ROM are not available to students for learning on campuses in Ondo State. Premised on research question, the study found out that students have regular access to email account and internet facility for search of information while students rarely have access to computer systems, Public Address System (P.A.S), E-Library facility, printers to prints learning materials, social-media platforms for learning and stored lectures notes on CD-ROMs for students supplementary learning. However, the study further revealed that computer training classes and projectors for academic activities are not accessed by students on campus.

Conclusion

Information communication technologies are influencing all aspects of life including education. They are promoting changes in working conditions, handling and exchanging of information, teaching-learning approaches and so on. One area in which the impacts of ICT is significant, is education. ICTs are making major differences in the teaching approaches and the ways students are learning. ICT-enhanced learning environment facilitates active, collaborative, creative, integrative, and evaluative learning as an advantage over the traditional method. In addition, the major promises of ICTs use in education systems of developing countries focus on training teachers in new skills and introducing innovative pedagogies into the classrooms, investing on ICT infrastructure for schools and creating networks among educational institutes, improving overall standard of education by reducing the gap in quality of education between schools in urban and rural areas, initiation of smart school with objectives to foster self-paced, self-assessed, and self-directed learning through the applications of ICTs, and developing ICT policy for education and training.

References

- Afolabi A.O (2009). Clogs in the wheel of ICTs for Higher Education Research in African: The way forward. J. Res. Educ. 6(12):190-203.
- Akinfolarin A.V (2014) Role of Sport in Education. Eagle Reporters; Nigerian Online Newspaper.<http://eaglereporters.com/2014/06/16/role-of-sport-in-educationbyakinfolarin-akinwale-v-bed/>. June 16, 2014.
- Brush, T., Glazewski, K. D. and Hew, K. F., (2008). Development of an instrument to measure pre-service teachers' technology skills, technology beliefs, and technology barriers. Computers in the Schools, vol. 25, pp.112-125.
- Castro Sánchez, J. J. & Alemán, E. C., 2011. Teachers' opinion survey on the use of ICT tools to support attendance-based teaching. Journal Computers and Education, vol. 56, pp.911-915.
- Gateway, D.R. (2010). Defining ICT in Education. Retrieved 3/10/2010, from: <http://www.rwandagateway.org/ICT4E/spip.php?rubrique6>
- Ifueko Omoigui Okauru (2011) "Emerging Issues In Tax Administration: The Way Forward" Being a Lecture delivered at the 4TH National Conference Of The Dept. of Finance, Faculty of Business Administration, University Of Lagos on July 12th, 2011.
- Hare, H. (2007). Survey of ICT and Education in Africa: Ethiopia Country Report (ICT in Education in Ethiopia). www.infodev.org downloaded February 28
- Kozma, R.B, (2005). National policies that connect ICT-based education reform to economic and social development. An interdisciplinary journal of humans in ICT environment 1(2) 117-156
- Tinio, V.L. (2002). ICT in Education: UN Development Programme. (Retrieved from <http://www.eprmers.org> on December 2009)
- UNESCO (2002). Information and Communication Technologies in Teacher Education, A Planning Guide. Paris: UNESCO.
- Volman M. (2005). Variety of roles for a new type of teacher. Educational technology and the teacher profession. Teacher and Teacher Education, 21, 15-31.
- Watson, D.M. (2001). Pedagogy before Technology: Re-thinking the Relationship between ICT and Teaching. Education and Information Technologies, 6, 4, 251-266

THE IMPACT OF STAFF MOTIVATION ON THE PERFORMANCE OF AN ORGANIZATION

ABIMBOLA E.O

Department of Business Administration,
Villanova Polytechnic Imesi Ile,
Osun State
olawaleesther@gmail.com

Abstract

The purpose for this study is to discover impact of employee motivation on organizational performance and examining the relationship between rewards systems of organizational performance. This study was designed based on the literature, connecting the impact of employee motivation on organizational performance and relationship between reward systems on organizational performance. The objectives were constructed based on the literature and the model was tested in perspective of the past studies and literature. The literature and different examination concluded that employee motivation has positive impact on organizational performance and also there is relationship between reward systems on organizational performance. The outcome demonstrated that if employees are positively motivated and rewarded, it improves both them viability and productivity definitely to increase organizational performance, workers are the core of any organization. For any organization to operate smoothly and without any interruption, employee motivation cannot be supplanted with anything else. It is of most extreme significance that the employees of any association not just have a decent motivation; likewise, managers and employers should maintain and fix reward system of their organizations.

Keywords: Motivation, Performance, Organization, Productivity, Employee

Introduction

All organizations want to be successful, even in current environment which is highly competitive. Therefore, companies irrespective of size and market, strive to motives their best employees, acknowledging their important role and influence on organizational effectiveness (Dobre, 2013). In order to encourage performance, companies should create a strong and positive relationship with its employees and direct them towards task fulfillment (Albeiti, 2015). In order to achieve their goals and objectives, organizations develop strategies to compete in highly competitive markets and to increase their performance (Knall & Mujtaba, 2010). Nevertheless, just a few organizations consider the human capital as being their main asset, capable of leading them to success or if not managed properly, to decline (Bartol & Marin, 2012). This implies that, if employees are not satisfied with their jobs and not motivated to fulfill their tasks and achieve their goals, the organization cannot attain success.

As stated, the performance of employees is a concern for any organization because it determines whether the organization meet its targets and goals. Various resources are

necessary for an organization to succeed and meet its target, and this includes the human resource or employees (Shank, 2012). However, skilled and talented employees may not achieve the desired results if they lack motivation and therefore, motivation is also considered an important value which is vital in the achievement of the organization's goals (Osei, 2011). Due to lack of motivation employees would not give their all to the organization as they will distribute their time to other non-work-related activities such as long lunch hours or surfing the internet for non-related purposes (Shanks, 2012).

In other words, motivation is an internal drive to satisfy an unsatisfied need and to achieve a certain goal. It is also a procedure that begins through a physiological or psychological need that stimulates a performance set by an objective. Shank (2012) defined motivation as the act of providing motive that causes someone to act, but note that, only an individual person can decide if they are going to be motivated.

Having looked at motivation, we now look at employee performance and what it entails. In every organization, there are many factors that come into play if the organization is to meet its targets. However, employees are the most important resource to the organization because they contribute to innovation, adjustment and other important values that would not be done by other resources such as machinery (Uzoma, 2013). Employees mainly perform tasks like manufacturing, marketing, production, transportation, storage, distribution, purchasing, promotion of business, finance and accounting, human resource, research and public relations (Dinler, 2008). Employees need to give their best in all these activities as the activities are inter-related and to achieve the organization's goals all have to be done properly (Yazici, 2008).

Performance of the employee is considered as what an employee does and what he does not do. Employee performance involves quality and quantity of output, presence at work, accommodative and helpful nature and timelessness of output. According to the results of the study conducted by Yang (2008) on individual performance showed that performance of the individuals cannot be verified by their level of performance. Similarly, he asserts that organizations can use direct bonuses and rewards based on individual performance if employee performance is noticeable.

Several studies have been carried out relating to employee motivation, but few have focused on its impact on employees' performance, rather focusing on the motivational techniques (Dinler, 2008). A study by Uzoma (2013) revealed that employees from different regions and cultures would not be motivated using the same motivational techniques meaning that different techniques may need to be applied for different regions and cultures. Asim (2013) found that training is an important motivational technique that leads to a positive impact on employee performance in the educational sector in Pakistan. However, the study only focused on training as a source of motivation leaving a gap to be filled by examining other motivational techniques.

This study investigates the relationship between motivation and the level of employee performance. This study is aimed at looking at possible areas of workers can be motivated to increase their level of performance and high productivity. No matter how good any organization is, it does not get anything done properly until the people who

make the organization do it. The objective of this study is aimed at describing what motivation is, where it comes from and why managers need to promote high level of it for an organization to be effective and achieve its goals.

The impact of staff motivation on the performance of an organization

What is impact of motivation?

- i) Motivation has a great impact on employee's performance.
- ii) Motivation has an influence on the employee's job performance.
- iii) Motivation has a relationship between production and productivity.
- iv) Motivation has a great significance on organizational effectiveness.

The impact of motivation on the employee's performance

That employee who is motivated is always aware of the objectives to be completed and leads his/her determination at achieving that aim. In the organization motivation impact on employee performance especially those employees who have less skill they are motivated more and contribute 100 percent with their work.

Importance of Motivation

- i) **Improves performance level:** The ability to do work and willingness to do work both affect the efficiency of a person. The ability to do work is obtained with the help of motivation. Willingness is more important in comparison to ability. For example, a person is highly educated and he is recruited on this very basis. But it is not essential that he will do outstanding work.
- ii) **Helps to change negatives or indifferent attitudes of employees:** Some employees of an organization have a negative attitude. They always think doing more work will not bring any
- iii) **Reduction in employee turnover:** The reputation of an organization is affected by the employee turnover. This creates a lot of problems for the managers. A lot of time and money do waste in repeatedly recruiting employees and giving them education and training. Only motivation can serve an organization from such wastage. Motivated people work for a longer time in the organization and there is a decline in the rate of turnover.
- iv) **Leads to stability of work force:** Stability of workforce is very important from the point of view of reputation and good will of a concern. The employees can remain loyal to the enterprises only when they have a feeling of participation in the management. The skills and efficiency of employees will always be of advantage to employees. this will lead to a good public image in the market which will attract competent and qualified people into a concern.

Meaning of Motivation

It is useful to review some of the major classifications of motivation theories since different theoretical perspectives shed light on how motivation influences work performance. According to Kreitner and Kinicki (2004) the term motivation is derived

from the Latin word 'movere' to move. Motivation represents those psychological process that cause the arousal, direction and persistence of voluntary actions that are goal directed. They continue to say motivation involves a host of psychological processes that culminate in an individual desire and intentions to behave in a particular way. Herseiman (2001) explain motivation at work is generally defined as a series of energizing forces that originate both within and beyond an individual's self. Such forces determine the nature, intensity and duration of a person's work behavior and therefore influence their productivity.

Many different motivational theories have been published for example, the reinforcement theories and instrumental theories but for the purpose of this study, only content and process theories will be discussed as the researcher found then to be most suitable. Content theories assume that all individuals possess the same set of needs and therefore prescribed the characteristics that ought to be present in jobs process theories stress the differences in people's needs and focus on the cognitive process that create these differences.

Content Theories (Psychological Need Theories)

According to Stoner et al (1985) the content theories are associated with names such as Maslow, McGregor, Hertzberg, Atrinson, Aderfer and McClelland, but only a few of these theorists will be discussed by the researcher to explain this kind of theory.

Maslow, in 1954, outlined the most influential of content theories. Maslow suggested a hierarchy of needs that progresses once an individual has satisfied one need in the hierarchy, it ceases their behavior and they are motivated by the need at the next level up the hierarchy.

The theory suggests that employees will always tend to want more from their employers. When they have satisfied their subsistence needs, they strive to fulfill security needs. When jobs are secure they will seek ways of satisfying social needs and if successful they will seek to satisfy their needs to the ultimate end of the hierarchy self-actualization.

If one examine the origin of Maslow's theory it is clear that it was not intended as an explanation of motivation in the workplace; however, many managerial theorist have adopted it enthusiastically and it has gained a lot of support from motivation and management scholars over the years. It is repeatedly referred to by different researchers. In 1895, Elbert and Discenza (1985) suggested practices that satisfy various levels of human needs based on Maslow's hierarchy of needs and these are still relevant to date, as listed below:

- Physiological needs
- Security needs
- Social needs
- Self- esteem needs
- Self-actualization needs.

Manager and leaders who understand this motivational theory are in a better position to nurture their employees as they go through different motivational hierarchy, stages, for example. It is easier to motivate employees who are on the social need hierarchy level by encouraging them to be part of the practical team to handle and to come up with a solution for different projects. In agreement, Luthans (2005) further indicates that the key to understanding the process of motivational lies in the meaning and relationship among needs, drives and incentives.

In addition to the Maslow's hierarchy of needs, Alderfer in 1972 suggested that individual needs can be divided into three groups.

1. Existence needs, which include nutritional and material requirement (at work, this would include pay and condition).
2. Relatedness needs, which are met through relationships with family and friends and at work with colleagues.
3. Growth needs, which reflect a desire for personal psychological development.

Process Theories /Expectancy Theory

Instead of emphasizing the content of needs and the driving nature of those needs, the process approach emphasizes how and by what goals individuals are motivated, basic to process theories in the notion of expectancy; what a person anticipates is likely to occur as a result of their behavior. Again, only few theorists will be discussed below.

Hertzberg (1996) presented a two factor theory, which looks at motivators and hygiene factors. Hertzberg proposed that job satisfaction and dissatisfaction appeared to be caused by two sets of different factors. For example, Hertzberg theory suggests that the presence of motivators in the work place caused enduring states of motivation in employees, but its absence did not need to dissatisfaction. Hygiene on the other hand produced and acceptable working environment, but did not increase satisfaction its absence did, however, cause job dissatisfaction.

Job satisfaction is another researchable topic on its own. Even though the aim of this study is not to evaluate job satisfaction, it is important to indicate that job dissatisfaction would also have negative impact on employees' job performance. Management, in their quest to motivate employees, should try to avoid those aspects that cause job dissatisfaction for employees. Similar importance in this approach is the employees' expectancy. Rue and Byars (2003) state that, the expectancy approach to motivation is based on the idea that employees belief about the relationship between effort, performance and outcome that determine their level of motivation. What can be learned from different motivational theories is the fact that employees do have different needs that they must fulfill, whether this needs happens in hierarchy order, or whether they are related to the nature of employees work; some might even be personal needs which they may finds ways to fulfill though their job. It is important to acknowledge the fact that motivation is generated or derived from personal desire to fulfill personal needs and this can be enhanced to improve job performance.

Meaning of Performance

Another important factor in this study is the concept of performance. Performance is action in accordance with requirements and expectation; OED (1978) simply defined performance is a qualitative measure of how things are done in relation to set standards within reasonable time frames.

The employer's main aim is to reach the organizational goals with the assistance of their staff, and the impact of this is then measured by determining whether employees perform their duties better than they did prior to motivation efforts, and that productivity or service delivery is high or within the set standards.

Once motivational strategies are in place it becomes very important for the organization to measure employee performance to ensure that is according to set standards. In addition, Kermally (1997) suggested the following reasons for measuring employees' performance:

- It is a means of communicating corporate objectives.
- It is a way of synchronizing department or team objectives with strategies objectives.
- It establishes congruence between employees' expectations and corporate goals.
- People feels they are valued
- It is SWOT (strengths, weakness, opportunities and threats) for employees.
- In some organizations it is used for salary review or promotion of employees, or even transfer of employees.

Relationship between Motivation and Employee Performance

Lee and Bruvoid (2003) suggest that need for management to invest in the development of employees as it helps to maintain and develop the level of skills, knowledge and abilities of employees and business organization. When the employees are not properly or adequately motivated, there are chances of failure to achieve the goals which can cause a decline in their self-efficacy Ordenez et al (2009)

According to Bandura (1997) there are no reporting that higher self-efficacy in employees affects the achievement.

Impact of Monetary Factors on Employee Performance

According to Wallace & Zeffane (2011), management depend upon rewards like money as the main factor of motivation because according to Maslow's hierarchy of needs, money is a unique reward that can satisfy different needs such as physiological need for food. In McClelland's acquired needs theory, money is an important source of performance feedback for high-need achievers.

Non-monetary rewards on the other hand attract persons with a high need for affiliation through verbal recognition, and high achievers through challenging jobs. Skinner (2005) argued that, the use of rewards in the classic work performance paradigm

is based primarily on the reinforcement theory which focuses on the relationship between a target behavior such as high performance and its consequences for example pay (Langton & Robbins, (2007). This study was framed from Herzberg's two factors and Skinner's Reinforcement.

Rewards are divided by Armstrong (2007) into two group; these are monetary and non-monetary rewards. The monetary rewards include base, merit pay, incentives, commission, bonus and healthy allowances. Non-monetary rewards include recognition, decision making roles, promotion, flexible working hours and company uniforms. He further indicated that employees are rewarded in accordance with their contribution, skill and competence and their market worth.

Summary

The study showed that employees acquire training aimed at improving their knowledge, skills and attitudes towards their work; as well as increase their morale and confidence in the job.

Conclusion

Management should use monetary reward to motivate its employees. Since employee believe that money is a crucial incentive to work. Motivation and most of them used the value of money as a scorecard by which they passed the value that the organization had placed on their services.

Recommendation

The study recommends that management to retain the non-monetary rewards as a cost-effective way of keeping the workforce highly motivated but also include monetary rewards that should be linked directly to the compensation plan.

References

- Ahamad, M, B., Wasay, E., & Malik, S. U. (2012). Impact of Employee Motivation on Customer Satisfaction: Study of Airline Industry in Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*, 4(6), 531-539.
- Albeiti, M. (2015). The Role of Motivation on Employees' Performance: The Case of Victoria Commercial Bank of Kenya. Unpublished MBA, Thesis. United States International University – Africa.
- Alderfer F. (1972). Organizational Behavior and Management. Theories of Motivation.
- Armstrong, M. (2013). Organization and People Employee Reward. Broadway, SW: CIPD publishers.

Armstrong, M. (2011). *A Handbook of Performance Management*. (4th Ed.) New Delhi, IN: Kogan Page Limited.

Cooper, D. R., & Schindler, P.S. (2011). *Business Research Methods*. (11th Ed.). New York.

Drake, A. R., Wong, J. & Salter, S.B. 2007. Empowerment, motivation, and performance: examining the impact of feedback and incentives on non-management employees. *Behavioral research in accounting*, 19: 71-89.

Hema S. (2016) why motivation is important in an organization. Retrieved from <https://www.Linkedin.com>.

Lee P. & Bruvoid C. (2003). The impact of human resources on organizational Performance: progress and prospect, *Academy of management. Journal* 39: 801-825

Maslow A.E (1954) *Organizational behavior and management* (4th Ed :) Theories of motivation pg. 155-177

Uzona, U. R. (2003). Impact of motivation on Employees Performance: A key Study of Credit West Cyprus. *Academy of Journal*, 15, 2-29

Dobre, O. I. (2013). Employee motivation and organization performance. *Review of Applied Socio-Economic Research*, 5(1), 53-60

Shanks, N. H. (2012). *Management and Motivation*. As cited in Jones and Barlett, 23-25. Retrieved from <http://www.Skill2lead.com/Southwest-airlines-employee> (Accessed 13/02/2016)

Yazici, N. K. (2008). *The Effect of Reward System Applications on Employee Performance in service sector*. Unpublished MBA, Thesis. Marmara University, Institute of Social Sciences

FACE BASED ACCESS CONTROL SYSTEM FOR DOCUMENT IDENTIFICATION

Oni, E. O

Department of Computer Engineering,
Villanova Polytechnic Imesi-Ile,
Osun State Nigeria
opson2k5@gmail.com,

Oketoyan, R.B

Department of Computer Engineering,
Villanova Polytechnic Imesi-Ile,
Osun State Nigeria
oketoyanruth81@gmail.com,

Abstract

The need for controlling the access of unauthorized users to data and information on personal computers in industries and organizational systems has been done using different methods in the past ranging from cards, passwords, one-time passwords but the complaints from people; forgetting the passwords, hacking of passwords, losing the cards etc. brought the new idea of using biometric recognition which facial recognition is an example. This research work uses facial recognition as a means of controlling access to data and information, The 'FaceAuthApp' developed uses Microsoft Visual C# as the User interface programming language, SQLite database manager because it suits its offline purpose and the need for persistence which is one of the goals of the application to store the data while EmguCV, a .NET wrapper for Open CV shall be used for the facial detection. For document identification, the administrator who logs in will upload documents which will be accessible only to pre-registered users and give a wrong entry error in case of wrong input or face not detected. The system when fully deployed can be used to control access to classified document in an organization. It can also be used by single user to restrict different authorized and unauthorized user from viewing personal document.

Keywords: Biometric; Database; Passwords; Microsoft Visual

A. Introduction

Security management is the identification of an organization's assets (including people, buildings, machines, systems and information assets), followed by the development, documentation, and implementation of policies and procedures for protecting these assets (ISO/IEC 13335-1:2004).

An organization uses such security management procedures as asset and information classification, threat assessment, risk assessment, and risk analysis to identify threats, categorize assets, and rate system vulnerabilities so that they can

implement effective controls (Trinabrata Das). According to Schatz et al (2017), computer security, cyber security or information technology security (IT security) is the protection of computer systems from theft or damage to their hardware, software or electronic data, as well as from disruption or misdirection of the services they provide.

Authentication and access control are often combined into a single operation, so that access is approved based on successful authentication, or based on an anonymous access token. Authentication methods and tokens include passwords, biometric scans, physical keys, electronic keys and devices, hidden paths, social barriers, and monitoring by humans and automated systems.

Access control is a security technique that regulates who or what can view or use resources in a computing environment. It is a fundamental concept in security that minimizes risk to the business or organization (Margaret, 2018). There are two mode of access control: physical and logical. Physical access control limits access to campuses, buildings, rooms and physical IT assets. Logical access control limits connections to computer networks, system files and data.

Access control systems provide the essential services of authorization, identification and authentication (I&A), access approval, and accountability) where:

- i. authorization specifies what a subject can do,
 - ii. identification and authentication ensure that only legitimate subjects can log on to a system access approval grants access during operations, by association of users with the resources that they are allowed to access), based on the authorization policy,
 - iii. accountability identifies what a subject (or all subjects associated with a user) did
- Facial recognition is a category of biometric software that maps an individual's facial features mathematically and stores the data as a face print. The software uses deep learning algorithms to compare a live capture or digital image to the stored face print in order to verify an individual's identity. High-quality cameras in mobile devices have made facial recognition a viable option for authentication as well as identification (Margaret, 2019).

B. Literature Review

Access Control

Access to protected information must be restricted to people who are authorized to access the information. The computer programs, and in many cases the computers that process the information, must also be authorized. This requires that mechanisms be in place to control the access to protected information. The sophistication of the access control mechanisms should be in parity with the value of the information being protected; the more sensitive or valuable the information the stronger the control mechanisms need to be. The foundation on which access control mechanisms are built start with identification and authentication (Affendi: Coursehero).

Access control is generally considered in three steps: identification, authentication, and authorization. Identification is an assertion of who someone is or what something is.

Authentication is the act of verifying a claim of identity. There are three different types of information that can be used for authentication, something you know: things such as a PIN, a password, or your mother's maiden name. Something you have: a driver's license or a magnetic swipe card. Something you are: biometrics, including palm prints, fingerprints, voice prints and retina (eye) scans (Turner, 2016). Authorization, After a person, program or computer has successfully been identified and authenticated then it must be determined what informational resources they are permitted to access and what actions they will be allowed to perform (run, view, create, delete, or change). This is called authorization.

Types of Access Control

The main types of access control are:

- i. **Discretionary access control (DAC):** An access control method in which owners or administrators of the protected system, data or resource set the policies defining who or what is authorized to access the resource. Many of these systems enable administrators to limit the propagation of access rights. A common criticism of DAC systems is a lack of centralized control.
- ii. **Role-based access control (RBAC):** A widely used access control mechanism that restricts access to computer resources based on individuals or groups with defined business functions - executive level, engineer level 1 - rather than the identities of individual users. The role-based security model relies on a complex structure of role assignments, role authorizations and role permissions developed using role engineering to regulate employee access to systems. RBAC systems can be used to enforce MAC and DAC frameworks.
- iii. **Rule-based access control:** A security model in which the system administrator defines the rules that to govern access to resource objects. Often these rules are based on conditions, such as time of day or location. It is not uncommon to use some form of both rule-based access control and role-based access control to enforce access policies and procedures.
- iv. **Attribute-based access control (ABAC):** A methodology that manages access rights by evaluating a set of rules, policies and relationships using the attributes of users, systems and environmental conditions (Margaret, 2018).

Authentication Methods

- i. **Passwords:** It is the most common form of system identification and authentication mechanism, A password is a protected string of characters that is used to authenticate an individual, Password should be properly guaranteed, updated, and kept secret to provide and effective security (wikibooks)
- ii. **One-Time or Dynamic Passwords:** It is a token based system used for authentication purposes where the service is used only once, It is used in environments that require a higher level of security than static password provides

- iii. Cryptographic Keys: Uses private keys and Digital Signatures, Provides a higher level of security than passwords
- iv. Memory Cards: Holds information but cannot process them, More secure than passwords but costly. E.g.: Swipe cards, ATM cards
- v. Biometrics: Verifies an individual's identity by analyzing a unique personal attribute or behavior. It is the most effective and accurate method for verifying identification. It is the most expensive authentication mechanism

Biometric Recognition

Biometric recognition is the automated method of identifying a person based on their physiological characteristics. Those physiological characteristics can include biometrics such as fingerprints, finger veins, palms, retinas, irises, faces and voice (*Jain et al, 2008*). Biometrics is better than RFID card credentials, but historically the cost has limited the growth of these systems (*Bob, 2016*). New systems have recently been introduced that are less expensive and yet quite effective. They are also networking attached, making them very easy to install. The IP biometric reader integrates nicely with IP camera systems, and is now part of the overall safety and security system.

Challenges of Facial Recognition Systems

Overcoming the challenges of Facial recognition as explained above, several steps can be taken to optimize security, performance, and user experience.

- i. Automate capture of high-quality images: Software that automates capture of facial images analyzes the streaming video frames in real time. Image capture is automatically triggered once focus, facial positioning, lighting, and other image-capture details are verified for compliance with quality standards.
- ii. Perform robust liveness detection: Liveness detection algorithms distinguish between a printed, digital, video, and a live facial image. Passive liveness detection looks for indicators of a non-live image such as inconsistent features between foreground and background. Active liveness detection prompts the user to blink or shake his or her head to ascertain liveness. The combination of active and passive methods will yield the highest performance matching. Facial recognition analysis applications might also leverage a second modality such as voice to help assure liveness.
- iii. Use high-performance algorithms: In the past few years, machine learning algorithms have become the predominant method for automatically extracting the above information and then comparing it against other images.

Merits of Facial Recognition System

- i. It offers easy storage of templates in database.
- ii. It reduces the statistic complexities to recognize face image.
- iii. It involves no physical contact with the system.
- iv. It is more secured and convenient
- v. It is easy and safe to use also user friendly system
- vi. It saves time in accessing documents.

Demerits of Facial Recognition System

- i. Facial traits change over time.
- ii. Uniqueness is not guaranteed, for example, in case of identical twins.
- iii. If a candidate face shows different expressions such as light smile, then it can affect the result.
- iv. It requires adequate lighting to get correct input

C. Methodology

Design of Face Based Access Control System

The system design phase is the phase at which the system analysis is transformed into a physical design and this usually involves different aspects such as:

- i. Object oriented design (OOD)
- ii. Database design
- iii. System flowchart
- iv. Interface design.

Unified Modelling Language for Face Based Access Control System

A very useful tool for object-oriented design is the UML (Unified Modelling Language) which is an industry standard tool for describing object orientation in form of analysis and design.

Database Design of Face Based Access Control System

One of the goals of any application is persistence and as such, we will need a database manager to help us stick with the rules. In this project, the researcher chose to make use of the SQLite database manager, primarily because it best suits this project for its offline purpose and also its robustness in managing BLOB (**B**inary **L**arge **O**bject) which shall be used to store the actual face in a pictorial format. The database has just one table named "faces" with four columns.

Face Based Access Control System Flowchart

A flowchart is a diagrammatic representation of an algorithm, a workflow or process. According to Wikipedia, flowcharts are used in designing and documenting simple processes or programs. Like other types of diagrams, they help visualize what is going on and thereby help understand a process and perhaps also find less-obvious features within the process, like flaws and bottlenecks.

Document access flowchart, is the platform that allows the user to access the uploaded documents. The user shows face in the camera, view documents otherwise, access is denied and then tried again. When face is detected and scanned through the open face database, if authorized, then access is granted to

The user authorization flowchart, allows the admin to supply its login details and if found to be correct grant an access for face to be scanned, trained, stored in the open face database. If face is not detected or not well shown due to poor illumination, it allows the face to be scanned again then trained and store up in the database.

It allows the admin to train more faces for new users and store it all up in the face database for authentication.

The document upload flowchart describes the only activity that differentiates the admin from the user in the faceAuthApp. After the admin has correctly filled in its details, the admin is permitted to upload document and store it in the locked folder. It allows two options in uploading the document: copy file and move file. Copy file option will allow the copied file to be accessed outside the faceAuthapp while the move file option will completely move the file from the source to the faceAuthapp and will not allow access to the file outside the faceAuthapp.

Face Based Access Control System Implementation

The aim of all meaningful software is to create a usable product that will be implemented and put to use or at least simulating the real world to solve a particular problem. Thus, the analysis and conceptual design of the application (system) is often followed by the actual development of the application (system).

Face Based Access Control System Documentation

System documentation is one of the most important aspects of software development. It is a written report of the entire operations of the designed and implemented program. Improper documentation of the system architecture will bring about difficulty when changes have to be implemented to the system functionality by another programmer. Unless the program modules are initially well written and adequately documented, maintenance is an extremely unattractive past time. The production of documentation must be seen as the writing of code itself. Provision of documentation is one of the greatest points to differentiate between amateur and professional programmers.

Face Based Access Control System Requirement

The system requirement for the development of this program include

- i. Hardware specification
- ii. Software specification

Hardware Specification

The system will require the following hardware components

- i. A complete computer set of at least Dual Core with a reasonable and size able hard disk space of at least 160GB and a RAM Size of at least 2GB.
- ii. External camera for system without inbuilt camera.
- iii. Shareable resources such as printer, scanner, etc. standard keyboard, Microsoft compatible mouse, UPS devices and VGA Color monitor.

Software Specification

The system will require the following software

- i. Microsoft windows 7 or later versions.
- ii. Visual Studio 2010 or later.

System Testing and Debugging

Writing code for a program is not enough to validate the program in other to check whether it produces the correct result. Testing represents the ultimate review of specification design and implementation which is the process of executing a program with the fore-knowledge of locating errors.

Installing the program from the control environment to the operational environment is to produce error, a successful test locates those errors, so that it is able to perform the designated task programmed to run. Testing the program after coding would check if these are functional:

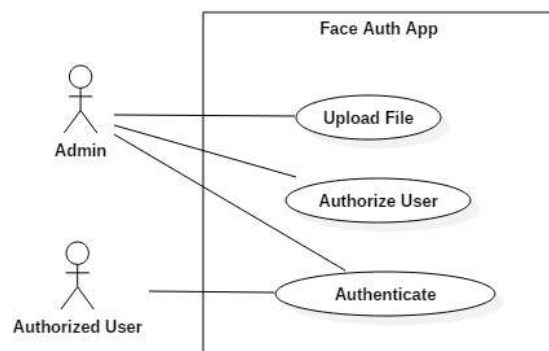
- i. Accurate performance of control function
- ii. Sound communication of data between each of the subprogram
- iii. Definite execution of each component program.

D. Evaluation of the Face Based Access Control System

Evaluation of the face based access control system was done using parameters such as:

- i. The error rate (False Acceptance Rate and False rejection rate).
- ii. Size of the software
- iii. Memory consumption
- iv. Speed of authenticating
- v. Scanning accuracy

There are basically two actors that exist in the modeling of the application, and the actors are the administrator and authorized Users of the application. Both users can access the documents in the locked folder only by passing their face through the camera for authentication while only the Administrator can upload files and store them in the locked folder automatically by the system providing an interface for copying or moving files from the selected source to the destination path, as well as authorizing Users who may have access to the locked files also. Use Case Modeling was used in the analysis.



Use Case Diagrams for Face Auth Access App

Summary of Face Based Access Control System

It is essential to note that the application seeks to secure documents which are placed in a folder, and for such documents in the folder to be secure, there is need to lock such

folder. The application readily locks the folder where all the files are kept, unless an authorized user successfully gains access to the application; in this case, the application unlocks the folder, so as to permit access to those files in the folder.

The user gains access to the documents by authenticating the face with the supplied parameters of ID and Name, if these parameters match with the face of the user, then the user is granted access to the files, otherwise, the user is denied access to the documents. In order to authorize a face or upload documents, the administrator is the only allowed personnel that can authorize face or upload documents, hence, the administrator enters the login parameters to upload documents and then proceeds to train the face in case of authorizing a User.

Face Based Access Control System Evaluation Results

Using the parameters listed in chapter three, the face based access control system was evaluated and it was realised that the error rate is been determined by the illumination of the environment. If the environment is well illuminated it will work accurately in scanning the face of the user and also authenticate the right user. The size of the software is 159MB which is good enough for system based software and for easier installation on systems. The memory consumption is based on the number of users been authorized by the user which is saved in the face database. Speed of authenticating a user for accessing a file is also accepted to be good for optimal performance and the Scanning Accuracy is also evaluated to be accurate enough for controlling the access documents.

E. Conclusion And Recommendation

Conclusion

In an environment where the usage folders and files are essential, it is imperative to secure such files in a way that it is inaccessible to an external user who has not been granted access. While it is easy to crack passwords and in fact, the probability of forgetting passwords are so high these days, it is not that easy, if possible at all to break through a secure system by the means of human characteristics such as the face, Iris, fingerprint to list a few.

It is usually quite difficult to try out something new especially something that may require a higher cost of computation than what it used to be but Clients who will use the application should be keen on being up to date in the area of technological advancements by harnessing the functionalities that this application provides.

This project can be a stepping-stone to a greater feat, which is achievable through a wider range of thinking using the developed application as the basis for an even better application. No single application is perfect, there is always an improvement. Conclusively, authorization and authentication require a higher computing functionality such as the processing power CPU, the RAM, the secondary storage because the human characteristics in the case of this project, the face of the User, has to be trained and stored in the database.

Recommendation

The system when fully deployed can be used to control access to classified document in an organization. It can also be used by single user to restrict different authorized and unauthorized user from viewing personal document.

References

1. Aneem Komachi 2009: <https://faceattendance.blogspot.com/2009/12/>
2. Blick_Maestro: <https://www.coursehero.com/file/39331854/10-Disadvantages-Of-Biometricsdocx/>
3. Bob Mesnik 2016: <https://www.linkedin.com/pulse/fingerprint-facial-recognition-access-control-jensen-gooduun-lion->
4. Dr. Affendi: <https://www.coursehero.com/file/p49gu12/Access-mechanism-Access-to-protected-information-must-be-restricted-to-people>
5. Foreman, P: Vulnerability Management, page 1. Taylor & Francis Group, 2010. ISBN 978-1- 4398-0150-5
6. <https://biometrictoday.com/10-advantages-disadvantages-biometrics-technology/>
7. https://en.wikibooks.org/wiki/Fundamentals_of_information_systems_security/access_control_systems
8. "Introduction to Biometrics". In Jain, AK; Flynn; Ross, A (eds.). *Handbook of Biometrics*. Springer. pp. 1–22. ISBN 978-0-387-71040-2. Archived from the original on 9 March 2011.
9. ISO/IEC 13335-1:2004 Information technology -- Security techniques -- Management of information and communications technology security -- Part 1: Concepts and models for information and communications technology security management
10. Margaret rouse 2018: <https://searchsecurity.techtarget.com/definition/access-control>
11. Margaret Rouse 2019: <https://searchsecurity.techtarget.com/definition/biometrics>
12. Prof. Hena Vedi: https://www.academia.edu/31640996/BIOMETRICS_A_Seminar_Report
13. Ramya: <http://www.m2sys.com/blog/biometric-hardware/advantages-biometric-identification-management-system/>
14. S. Obaidat, Mohammad & Rana, Soumya & Maitra, Tanmoy & Giri, Debasis & Dutta, Subrata. (2018). Biometric Security and Internet of Things (IoT). 10.1007/978-3-319-98734-7_19.
15. Schatz, Daniel; Bashroush, Rabih; Wall, Julie (2017). "Towards a More Representative Definition of Cyber Security". *Journal of Digital Forensics, Security and Law*. 12 (2). ISSN 1558-7215
16. TrinabrataDas: <https://rbu.academia.edu/TrinabrataDas>
17. Turner, Dawn M. "Digital Authentication: The Basics". *Cryptomathic*. Archived from the original on 14 August 2016. Retrieved 9 August 2016.

MANAGERIAL SCHEDULING AS CORRELATES OF ADMINISTRATIVE EFFECTIVENESS IN HIGHER INSTITUTIONS IN EKITI STATE, NIGERIA

Prof. KANU, Ikechukwu Anthony (OSA)

Department of Philosophy and Religious Studies

Tansian University, Umunya

Anambra State

ikee_mario@yahoo.com

&

Dr. OMOJOLA Immaculata Olu, (SSMA)

Department of Business Administration and Management

Villanova Polytechnic Imesi Ile

Osun State

omojolassma@yahoo.co.uk

Abstract

This study examined managerial scheduling as correlates of administrative effectiveness in higher institutions in Ekiti State, Nigeria. The relationship between scheduling and administrative effectiveness were discussed. The sample for the study was 150 administrators and 300 academic and non-academic staff, who rated the administrators. They were selected using simple random and purposive random sampling techniques. An instrument tagged "Questionnaire on scheduling as correlates of administrative effectiveness in higher institutions in Ekiti State Nigeria (QSC)" and "Questionnaire on Administrative Effectiveness in Higher Institutions in Ekiti State, Nigeria (For Academic and Non - Academic staff)" (QAE) was used. The data collected were analyzed using percentage, mean, standard deviation and Pearson's product moment correlation analysis. All the hypotheses were tested at 0.05 level of significance. Face and content were used to establish the validity of the Instruments. To ascertain the reliability of the instruments, the split half method was used. They were found to be 0.84 and 0.87 for (QSC) and (QAE) respectively. The findings revealed that scheduling is greatly related to administrative effectiveness. Based on the findings of the study, it was recommended that administrators of higher institutions like Vice Chancellors, Rectors, Provosts, Registrars, Bursars, Librarians, Directors of Program, Assistant Director of Program and Heads of departments should regularly assign fixed time for events and strictly adhere to it for the improvement of administrative work.

Keywords: Scheduling, Higher Institutions, Administrative Effectiveness, Ekiti State, Vice Chancellor, Rectors and Nigeria.

Introduction

Administrative scheduling can be considered as one of the major problems of Administrators in higher institutions especially in Ekiti State, Nigeria. Scheduling is a way of arranging events or programs that are to take place. Schedule in management identifies what to do, make plans and allocate time, execute and report the action as it was carried out. Scheduling in University system has much influence on the Administrators. In this case, Administrators are Vice Chancellor, Deputy Vice Chancellor, Registrar, Director of Programs, Assistance Director of Programs, Bursars and Heads of Departments. Scheduling has a lot to do with the way and manner with which their time is being planned to meet their daily schedule. In performing their daily schedule, most of the time, attention might not be paid to how events are being carried out behind schedule.

Imagine a situation where academic calendar is not ready before resumption, therefore, resumption date comes behind schedule. As soon as allocation of courses to respective lecturers is done behind schedule, lectures must begin behind schedule as well. This in some cases might affect examination time and time table preparation. There might be cases where examinations time table are altered without much notification. Administrative effectiveness is more than getting things done but accomplishing events at the appropriate time as in the mind of Momoh and Obiweluzor (2015), "effectiveness means to bring about or to accomplish; thus before an action, or an institution or an individual is regarded as effective, there must be an accomplishment." p.1. Supporting this definition is McCrimmon (2007)'s findings that effective administration entails efficiency, getting things done with least cost.

Literature Review

Scheduling is the process by which work is planned for effectiveness and it is best done on a regular basis, for example, at the start of every week or month. Therefore, scheduling must be a thing of consistent practice. After all work has been done, the time remaining is "discretionary time" which can be used to address other priorities and personal goals. This is a reasonable assertion especially when diary, calendar, electronic organizer and paper based organizer are used depending on individual's circumstances. It will eventually help administrators to carry out their work effectively.

According to Fiore 2016, scheduling has the following steps: Identifying the time you want to make available for work, which depends on the design of job, fix-in the actions to be performed, review to-do list and schedule in the high-priority/urgent activities, as well as the essential maintenance tasks that cannot be delegated and cannot

be avoided, since interruptions cannot be predicted, it is good to have spaces in-between schedule. This means there should be flexibility to rearrange your schedule to react effectively to issues as they arise.

Achunine and Irondi (1998) present a format of scheduling in relation to school system as follows: 1) School goal- to provide more security for the school properties. Activities- (a) Building fences, (b) Providing burglary proof for windows and doors and (c) Hiring security men. 2) School goals- involving the community more closely in school affairs. On activities - (a) Arranging PTA meetings, (b) Arranging Old Boys' forum, (c) Arranging School Day, (d) Arranging School's social/cultural day activities. 3) School goals- introducing science programs for the school, Activities- (a) Recruiting science teachers, (b) Procurement of science instructional materials, and (c) Developing science curriculum/laboratories. The authors relate their idea to school system, although not in a fixed pattern. Administrators can use the model to develop theirs which will assist them to be more effective.

In the proposal of Adesina and Fagbemiye (2007) on time scheduling and time allocation to tasks based on how educationally productive they are for ensuring effectiveness, they grouped the numerous functions of the school administrator into three categories: the professional goal functions, the critical/crisis functions and the maintenance functions, with the professional goal functions at the apex of the ladder and the maintenance functions at the base of the ladder in order of priority.

The professional goal functions embrace all efforts by the administrator towards the development and implementation of the curriculum and instructional matters that lead directly to effective teaching and learning. Maintenance functions embrace all routine management tasks geared towards maintaining stability and status quo in the school. The middle level critical/crises functions embrace mostly activities critical to students, personnel administration and fiscal management. These authors maintain that even though the maintenance function at the base of the scheduling ladder has more activities in the school program than the professional goal functions, they have to be treated quickly to save time for the more educationally productive professional goal functions which are the topmost priority tasks in school administration.

When the tasks are scheduled and prioritised, this should be followed by an estimate of time needed to complete activities. By inference, tasks of first priority should be allocated more block time than the tasks of second priority. Scheduling practices will help administrators to do creative and educationally more productive work in the morning and use the afternoon for scheduled and unscheduled meetings with the public. It is very important to allocate larger quantum time at a stretch to programs of importance instead of allocating bits of time stretched out for a long period to the same function. For instance, allocate some two to three weeks in the year at a stretch for supervision of all teachers in the school, lasting for about three hours each day. This will give the administrator a clear and comprehensive picture of the direction the programs of the curriculum is going and what general and specific problems there are in relation to effective teaching and learning in the Universities. Allowances must however be made

for emergencies and unexpected events as they are bound to come up in any human Organization. Over-estimation of time should be preferred to under-estimation to avoid frustration of not meeting deadlines.

The Carnegie Council (1989) studied scheduling in relation to school system. Before 1958, Staff at all levels taught any subject at any time of the day. Later, a unit was agreed upon - comprised of approximately 50-minute class periods in which a single subject is taught, and for which teachers specialize in particular subject areas became the most frequently used in scheduling format. A document was published to back up their research. This caused schools to experiment with ungraded instruction, long periods of independent study and large group instruction. The plan failed, however, partly due to the large amount of unstructured, independent study time for students.

In the 1970s, the notion that flexibility in scheduling is beneficial to staff and students led to the open school concept. Divisions between classrooms in elementary schools were eliminated and students were able to progress at their own speed, moving from one grade level to another. During this period, some schools modified the traditional seven-period day, breaking the day up into 20-minute modules and calling the plan modular flexible scheduling. This plan was not successful.

Later, with flexibility continuing to be a priority, fluid block scheduling became popular and successful. This scheduling pattern allots a block of two to three hours to teams of teachers from various subject areas, allowing teachers to schedule instruction according to student needs. Another flexible scheduling alternative followed this step and continues in popularity is the zero period schedules. Designated courses begin an hour earlier than the regular school day, allowing some students to leave an hour earlier or enroll in an extra class.

The study of 1989 publication in *Turning Points*, by the Carnegie Council on Adolescent Development, brought major changes for middle-level schools. Recognizing that junior high schools were simply mirror images of high schools, the council recommended that schools be reconfigured to fit the developmental needs of young adolescents. Thus, various forms of block scheduling and interdisciplinary teaming took hold in middle schools, and later in high schools. With block scheduling, teachers are given longer periods of time - usually 90 - minutes to work with students. Interdisciplinary teaming is a popular arrangement where a group of teachers (usually four or five) work with 125 to 150 students, essentially creating a school within a school. Interdisciplinary units of study help students to understand the connections between subjects. Teaming is sometimes combined with block scheduling. Throughout the history of school scheduling, the need for flexibility and the need for teachers to work cooperatively for the benefit of students are recurring themes.

Carnegie council encourage administrators to make use of scheduling in school system at all levels as it involves some fundamental assessments; including examining what teachers are doing and determining if classroom instruction is improving students' achievement. When teachers make instruction optimally effective for students, it is appropriate to consider how the use of time could further enhance learning - the schedule

must support, not drive, the instructional program. As teachers become more innovative and experimental in their classroom activities, they adopt flexible and cooperative approaches that demand new organizational arrangements.

However, scheduling and scheduled activities will make educational evaluation easier. Failure to plan in the day leads the administrators into being managed by crises and events that just come up. He may need to react continuously to other people's actions and not acting on predetermined schedules. Such questions as these are pertinent in planning: when can this program take off and what is the appropriate time span for it? What are the possible interferences which can hinder the accomplishment of these tasks at the time estimated? All questions that relate to activity scheduling in terms of the various dimensions of planning must be answered if envisaged goals are to be achieved within time limit.

When tasks are scheduled, administrators should not allow urgent or unexpected events to derail their plan of activities. Quoting Mackenzie in Hughes and Ubben, Achunine and Irondi (1998) say: "Urgency engulfs the manager: yet the urgent task is not always the most important. The tyranny of the urgency lies in its distortion of priorities, its subtle clocking of minor projects with major status, often under guise of "crisis." One of the measures of the manager is his ability to distinguish the important from the urgent, to refuse to be tyrannized by the urgent, to refuse to be managed by crisis. Scheduling is a skill that involves the school administrator in making an inventory of specific activities which would lead to the subsequent realization of the long and short-term school goals. Goal setting and subsequent strategies developed to achieve those goals is the key to spending time productively. Time management strategies work hand-in-hand with planning, and, if not done properly, makes planned programs fail."

Achunine and Irondi sense that specific activities should be scheduled daily, weekly or monthly. Daily activities should be scheduled first thing in the morning. For the weekly and monthly activities, planning and scheduling may be done on the first day of the week or month. Administrators need to do much of their thinking on paper to avoid inspirational and creative ideas being wasted through forgetfulness. Through this, time will be properly managed. When tasks have been scheduled, the next move is to put the specific activities through which the goals of the school are expected to be achieved into a hierarchy, according to their degree of importance in enhancing productivity, from the most educationally productive to the least educationally matter.

Study Objectives

The objective of this study was to find out the relationship between managerial scheduling and administrative effectiveness in Higher Institutions in Ekiti State.

Method

The design of this research work is descriptive of correlational type. Correlation research relates existing characteristics of variables in a given sample. The study seeks to determine the degree of relationship between scheduling and administrative

effectiveness. The sample of the study was 450 respondents which comprised 150 administrators and 300 staff that rated the administrators.

Result, Analysis and Discussion

In the analysis of Data and discussion, the following are generated. **Hypothesis:** There is no relationship between administrators' time scheduling and administrative effectiveness in higher institutions.

Table 1:

Pearson correlation administrators' time scheduling and administrative effectiveness in higher institutions

Variable	N	r-cal	t-table
Scheduling	116	0.247*	0.195
Administrative effectiveness	116		

$p < 0.05$

This table shows that r-cal is 0.247* and r-table 0.195 which means that r-cal is greater than r-table at 0.05 level of significance. The null hypothesis is rejected. Therefore, there is significant relationship between scheduling and administrative effectiveness.

Recommendations

Based on the findings of this study, the following recommendations were made: Educational stakeholders, especially those in higher institutions like Vice Chancellors, Rectors, Provosts, Registrars, Bursars, Librarians, Directors of Program, Assistant director of Program and Heads of departments need to know the importance of time scheduling to their effectiveness. They have to be conscious of time in discharging their duties to avoid working behind schedule.

Conclusion

Based on the findings of this study, the following conclusions are drawn: Lack of proper Scheduling on the part of school administrators have some influences on certain areas in a school system especially in planning a new session's programme, altering lecture and examination time table and making approved budget available to time. This does result from not paying attention to time scheduling.

References

- Achunine, R. N & Ironi E. O (1998) (Eds) Management and administration of Secondary education in Nigeria, Lagos: Totan publishers Limited.
- Adesina, S. and Fagbemiye E. O (2007). *Educational administration*. Lagos: Irepo Printing Press.
- Carnegie Council on Adolescent Development (1989). Turning points: American youth for the 21st century. *The Report of Task Force on Education of Young Adolescents*.
- Fiore, A. (2016). *The Now Habit: A strategic program for overcoming Procrastination and enjoying guilt-free play*. New York: Penguin group
- McCrimmon, M. (2007). What is management effectiveness? Retrieved from: <http://mitchMCCRIMMON.suite101.com/whatismanagementeffectiveness-928590>.
- Momoh U. and Obiweleuzor N. (2015). Principals' Administrative Effectiveness in the Implementation of Quality Assurance Standards in Public Secondary Schools in Edo and Delta States. *Sokoto Educational Review*. Retrieved from : <https://www.researchgate.net/publication/333096188>

ISSUES AND TRENDS IN SCIENCE EDUCATION FOR SUSTAINABLE ECONOMIC DEVELOPMENT IN NIGERIA

BELLO, Moruff Ajadi

Department of Technical Education,
School of Vocational and Technical Education
Osun State College of Education, Ila-Orangun
E-mail: engrbellomoruff@gmail.com

Abstract

It is clearly noticeable that science education in the early 21st century is facing a myriad of issues in African countries particularly in Nigerian education system. Indeed, students in Nigeria still lag behind their counterpart in other nations in science achievement. Some of the complex issues in the field of science education include the availability of appropriate textbooks and classroom resources; the availability of financial support and curriculum resources; the preparation and training of science teachers (including both pre-service training and in-service professional development); political and religious opposition to cutting-edge science instruction; the need to meet standards and to prepare students for standardized examinations; and the dramatically increasing use of the internet as a source of information. Given these and other issues, it is extremely important to understand, acknowledge, and build upon the abilities of adolescent learners, while at the same time tailoring instruction to address the unique challenges faced by this age group. It is in the light of the above that this publication attempts to highlight the issues and trends in science education in Nigeria. The paper looks at the science education as a vehicle for sustainable economic development. The various challenges faced by science education were also discussed. Finally, the paper also provides way forward to the numerous challenges inhibiting the sustainable development of science education in Nigeria.

Keywords: Issues and Trends, Science Education, Challenges, Sustainable Economic Development.

Introduction

The satisfaction of human needs and aspirations has always been the major objective of development. For several decades, and particularly in the last century, economic growth and development had resulted in substantial improvements in health, education, and the quality of life for many people especially in the western countries. However, it has become very apparent that the global community, over these decades, has pursued a path of development which is clearly not sustainable. Thus, there are many reasons why education has to be regarded as the bedrock of sustainable development by all and sundry. According to the World Economic Forum Global Competitiveness Report (WEF 2016), education can be defined as the stock of skills, competencies, and other productivity, enhancing characteristics. The Forum further described education, as a

critical component of a country's human capital, increases the efficiency of each individual worker and helps economies to move up the value chain beyond manual tasks or simple production processes. The human capital which is a result of sound educational system has long been considered the most distinctive feature of the economic system and further studies have proven the impact of education on sustainable economic development in the society. Accordingly, educational system must be anchored on a sound philosophical foundation that encourages partnership for exchange of people, ideas and support facilities. This assertion indicates that education has a role to play in combating modern environmental and developmental challenges of the African continent and Nigeria in particular. The type of education that must be the priority of any nation must depend on the need of such nation. It is in line with this fact that Ogunmade (2006) added that for any nation including Nigeria to attain sustainable development; there is the need to recognize science education as a priority area of education for her citizens. This implies that no country can be globally recognized without talking about its scientific advancements. However, according to one of the key problems in evolving a development strategy for a developing country like Nigeria, is lack of the capacity for appreciation and application of science and technology through developmental efforts (Aina, 2012 as cited by Gabriel, 2019).

Science education is described by Pember & Humbe (2009) as a process of teaching or training especially, in school to improve one's knowledge about environment and to develop one's skill of systematic inquiry as well as natural attitudinal characteristics. Science education involves the study of science in depth and in addition, educational knowledge and concepts are learnt and verified. It has been recognized worldwide as a pre-requisite in technological development (Okoli et. al. 2013). This implies that no country can be globally recognized without talking about its scientific advancements. According to Lewis (2015) science education identifies natural phenomena appropriate to child interest and skills. Also, he went on to say that science education equips teachers, learners and the society with knowledge, skills, equipment and freedom to perform noble task useful for improving socioeconomic standard. In addition, he added that science education courses are designed to produce capable scientists who contribute meaningfully to academic excellence of the society to raise the economic level of nations.

Science is an area of learning that is absolutely necessary for development because of its linkage to technology and industry (Batomalague, 2015 as cited by Danjuma & Adakole 2019). Scientific development is essential for better quality of life, the sustainable development of the planet, and peaceful coexistence amongst peoples. From the immediate basic essentials of life such as access to water, food and shelter, to other issues such as management of agricultural production, water resources, health, energy resources, biodiversity, conservation, the environment, transport, communication, science provides the basis for action at local, regional, national and transnational levels (UNESCO, 2015). This is because Science and technology have been identified as the key drivers for growth and sustainable social development and transformation of nations, which could lead to industrialization (Uza, 2013 as cited by Danjuma & Adakole, 2019).

However, despite the above motioned roles of science education to national development, Nigeria lacked sustainable science education since its independence and as a result; science education has not been able to move the country into industrialization and above poverty level. Similarly, Momeke (2007) supported this assertion when he said that science education has failed to produce skilled human resources needed for transformation into national prosperity. This implies that most of Nigeria's development in the direction of modernization has been haphazard leading to acquisition of obsolete technology. Sustainable science education development therefore represents a catalytic process for social educational, training and public awareness – the values, behaviour and lifestyles required for a sustainable future (Okoli et al. 2013).

Worthy of note is the fact that only quality science education can bring about effective learning among students which will eventually produce undoubted development for any country. Quality science education is effective science teaching which occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge (Omoifo, 2012). Recent studies have reported that quality of teaching and teachers were dominant factors for student poor performance in science subjects. for instance, in a research conducted by Ayodeji et.al., (2018) on "science education in south-west Nigeria" it was found that many factors such as inadequately equipped laboratories, inadequate access to ICT by the in-school youth, low ratio of teacher to students are challenges in majority of the schools. Others factors include lack of textbooks, science equipment and facilities and poorly equipped laboratory rooms (Batomalague, 2015). Large class sizes, inadequate funding, insufficient curriculum resources, poor teaching skills and lack of supports for teachers among other factors further limit the quality of science teaching and learning in Nigerian schools (Okebukola 1997). Thus, improving scientific education has become of paramount importance in determining a country's socio-economic development of the country. Nevertheless, this may be difficult to achieve without the adequate understanding of the current status of science education and the means to improve it.

The Concepts of Science and Science Education

Science is an organized body of knowledge in form of concepts, laws, theories and generalizations. Urevbu (2001) defined science as a study of nature and natural phenomena in order to discover their principles and laws. Similarly, Gottlieb (2004) as cited by Christiana (2012) viewed science as an intellectual activity carried out by human that are designed to discover information about the natural world in which humans live and to discover the ways in which this information can be organized into meaningful patterns. That is, science could be described as the structure and behaviour of the physical and natural world and society, especially through observation and experience (Omole & Ozoji, 2014 as cited by Danjuma & Adakole, 2019). The definitions above reveal that science is linked with observation of the environment, which proper understanding is plausible through experimental process. It further shows that science is the sensory process of epistemological comprehension of nature that aids man logically discovers and

interprets the principles through which man controls his environment naturally. According to Danjuma, & Adakole, (2019), it is the process of penetrating nature with the aim of discovering the laws that aid man to live sustainably.

Education is the total process of human learning by which knowledge is impacted, faculties trained and skills developed (Urevbu, 2001). Hence, science education according to Omorogbe & Ewansiha (2013) is a field of study concerned with producing a scientifically literate society. It acquaints students with certain basic knowledge, skills and attitudes needed for future work in science and science related field. Agbowuro et al. (2015) listed five aims and objectives of science education thus;

- To excite and enthuse children with a sense of awe and wonder at the natural world.
- To give pupils enough evidence-based knowledge to be able to make informed personal judgments in order to live healthy, safe, comfortable and environmentally sustainable lives.
- To develop pupils' understanding and experience of the scientific method, to understand its value and limits, and to enable them to apply the method.
- To be proficient at practical work and use of scientific equipment
- To know, understand at an abstract level, and be able to apply important scientific theories.

Educational systems all over the world place serious emphasis on science and technology because of their implications on technological advancement which is tied to national development. This desire is the case with all developing nations including Nigeria.

The Concept of Sustainable Development

The concept of sustainability is a complex one and has been at the forefront of the development movement since 1982, when the United Nations Conference on the Human Environment adopted a declaration for preservation and enhancement of the human environment.

Singh and Titi (1992) defined sustainable development as a process of change in which the utilization of resources, the direction of investments, the orientation of technological innovation and exchange and institutional change reflect both future and present needs. Accordingly, the Global Action Programme (GAP) on Education for Sustainable Development, ESD stated that any approaches to development that balance economic and social progress, address cultural differences, conform to global, national and local needs, and respect ecological values and limits is the key to sustainable development.

That is why, it is worth note that neither the needed innovations in technology, economics, participatory politics, crossover financial processes between the wealthy and developing nations, as well as the transformation of consumption and lifestyle patterns aren't going to develop on their own, nor are they going to be the result of a gradual cultural advancement. What is necessary is a systematically facilitated, large-scale mental/psychological transformation. This doesn't mean just raising awareness in

general. Rather, every person must use the opportunity to acquire the special values and knowledge, also the skills and abilities which everyone will need to shape a future worth living. Thus, we have to learn sustainability in formal educational institutions, out-of-school settings and informal daily situations. Education is a necessary and substantial contribution toward the preventive measure of setting sustainable development in motion. Therefore, sustainable development processes cannot be implemented without the appropriate education. Corroborating this view, Klaus (2013) stated that education for sustainable development falls short when it limits itself to instruction and teaching processes. More essential is the encouragement of deeper insights into how to safeguard the future through sustainability, into justice, ecological compatibility, economic achievement, potential and social responsibility. There is already conflict about what goals should be within these dimensions of sustainability. He further opined that apart from this, every person has her/his own concept of sustainability, justice, economic necessity and responsibility of individuals, businesses and society. Education processes should allow for expression of these convictions and for reflection through dialogue with fellow learners.

From the foregoing, it is very clear that sustainable development draws global attention to the urgent need to address issues that have the potential to endanger our individual and collective existence and threaten to rob future generations of their wellbeing, as captured by Sampson (2013 as cited by Ajibade, 2013).

Science Education as a Vehicle for Sustainable Economic Development in Nigeria

The practical use of science through technology created the climate for ever increasing emphasis on the pursuit of science and education in developed countries, where funding scientific enterprises is widely accepted as a vital and long-term investment. What is emerging from this priority is the close association of education and economic growth. Accelerating the rate of growth and rate of productivity can basically be accomplished by stimulating and supporting scientific education in universities by stimulating and nurturing scientific and technical talent, and to the concomitant training of students (Sinclair, 1988).

Education has been widely recognized not only as a fundamental human right but also as a catalyst for sustainable development and a vehicle for confronting the challenges facing societies in terms of socio-economic, environmental and ecological realities, considerable attention is shifting towards it (Hanachor & Wordu, 2021).

Also, at the Earth Summit in Rio de Janeiro, Brazil in 1992, 150 nations endorsed Agenda 21 document. Chapter 36 of Agenda 21 specifically focused on the role of education in promoting public awareness and training in achieving environmental decision-making. In it, (UNCED, 1992), world leaders asserted that: education is critical for promoting sustainable development and improving the capacity of people to address environmental and development, environmental mid ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making.

The educational system is therefore expected to provide for the preparation and training of skilled human resources to manage the economy, to facilitate, by means of trained personnel, the generation and advancement of knowledge in pure and applied fields and to perform a consciousness - raising function with respect to the social, cultural, political, economic and physical environment.

In line with this, Gunmade (2006 as cited by Danjuma & Adakole, 2019) had reiterated that for Nigeria to attain sustainable development; there is need to recognize science education as a priority area of education for her citizens. This calls for the massive education of the citizens in science and science related courses. So also, there is the need to redesign the philosophy of science education in Nigeria. The 21st century requires citizens that are able to explore; understand and decide their own fate in the society on the basis of scientific and technological advancement. Hence, science education promotes and advocates scientific literacy and the practical application of scientific knowledge to bring about economic, environmental and societal development. Moreover, it must be emphasized that science courses create numerous opportunities for students to engage in doing activities that enable them translate the world around them, make new discoveries, solve social problems and develop skills that are sustainability driven. By and large, scientific knowledge is directed at addressing core objectives of sustainable development (economy, society and environment).

For Omoifo (2012), core science subjects expose students to natural phenomenal and help students understand the underlying principles of the world. Therefore, effective science education will help students understand their local, national and international milieu thereby preparing them for both man-made and natural environmental challenges; and measures to be taken while caring for environment(s). It is worthy to note that science educators have realized the necessity to become agents of change in order to achieve the goals of sustainable development and fulfill societal expectations about science education. That is, science education plays a crucial role in shaping the knowledge of students towards sustainable development (Danjuma & Adakole, 2019).

In recognition of science education as a vehicle for sustainable development in the country, Nigerian government like all other governments in the world realizes the role of science and its by product-technology in issues of national development. It is for this reason that their promotion is enshrined in section 18(2) of the 1999 Constitution of the Federal Republic of Nigeria. The goals of science education in Nigeria according to the National Policy on Education (FRN, 2004 as cited by Igbaji et al., 2017) are to:

- ✚ cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy;
- ✚ produce scientists for national development,
- ✚ service studies in technology and the cause of technological development;
- ✚ provide knowledge and understanding of the complexity of the physical world, the forms and the conduct of life.

To this end, the government set up a National Policy Implementation Committee to translate the policy into workable blue prints that would guide the bodies whose duty

it would be to implement the policy. The committee was also to develop monitoring system for educational plan as it evolved (Christiana, 2012).

However, Danjuma & Adakole (2019) affirmed that despite the laudable goals of science education to national development, Nigerians and indeed Nigeria have not harnessed the benefits of science since independence and as a result, science education has not been able to serve as a tool for sustainable development. This is because science education has failed to produce skilled human resources needed for sustainable development. The implication of this is that Nigeria does not have scientific and technological prowess to be among the leading scientific nations in the world- acquisition of obsolete technology (Momeke 2007).

Challenges Facing Science Education in Nigeria

According to Omorogbe & Ewansiha (2013), the 21st century is characterized by advancement in science and technology. Over the last two decades, there have been repeated calls for reforms and innovations aimed at improving science education in Nigeria. This suggests that there are issues in science education in Nigeria that require urgent attentions both collectively and individually. Hence, from the extensive review of researched literatures, and in a more comprehensive manner, the following have been identified as challenges facing sustainable science education in Nigeria.

❖ *Inadequate Funding*

There is gainsaying the fact that the success of any education programmes depends largely on financial support. This is because inadequate funding militates against the provision of quality education. Inadequate funding adversely affects the provision of infrastructure, facilities and sufficient number of workforce (teaching and non-teaching staff) needed to deliver quality science education for the recipients. Nwangwu (2004) reported that ill equipped workshops, libraries and laboratories exist because of serious shortfalls and inadequacies in education funding.

❖ *Lack of Instructional (Teaching and Learning) Materials*

Instructional materials are facilities, equipment or materials that the teacher uses to illustrate, emphasize and explain the lessons for better comprehension by the students. UNESCO (2000) equally confirmed that instructional materials are important in the actualization of the curriculum. Some aspects of science are full of abstract concepts which pose problems to the students in their understanding. Therefore, availability and use of instructional materials in teaching such difficult concepts will make for better understanding and thus enhance the objectives of science education. Experiments also allow students to observe non-intuitive phenomena they can then study in the course of resolving the gap between their intuition and the underlying physics or chemistry of an experiment. In this setting, a well-equipped laboratory can take advantage of versatile probe-ware and handheld devices to capture real data that can be transferred to a computer for further analysis and inclusion in a report. In other words, students benefit

when they do science, not just learn about science (David, 2009 as cited by Hamidu & Mohammed, 2015).

❖ *Shortage of Qualified Teachers*

Teacher–pupil ratio is a key challenge to teachers of science education. According to the objectives of science education, each student needs to have access to highly qualified teachers. And yet, in the areas of mathematics and science, such teachers seem to be in short supply. According to the Federal Republic of Nigeria (FRN, 2004), the teacher–pupil ratio should be 1:35. This is contrary to the 1:60 most schools have in most developing countries including Nigeria.

For science teachers to pass the message across effectively, they should be able to encourage the pupils positively, show love, recognize individual differences and plan cooperative teaching with the pupils. Conversely, the type and quality of interaction that exists in the classroom does not only determine the effectiveness of teaching and learning situation but also the attitudes, interest and even the personality of learners (Mbakwe, 2005 as cited by Ayodeji et al., 2018).

❖ *The difficult Nature of Science*

Scientific knowledge is by nature abstract and theoretical. It also often contradicts common sense, and is developed through controlled experiments in artificial and idealized laboratory settings. Learning science often requires hardwork and intellectual efforts, and concentration, which is not part of the present youth culture. In a world where so many channels compete for the attention of young people, such subjects become unpopular.

❖ *Inadequate Qualified Science Teachers*

Competent science teachers are not sufficient in public schools in Nigeria. Nada (2008) as cited by Christiana (2012) observed that the status of competency in secondary school appears to be very low. Stressing that majority of teachers who are already in the system seem to lack initiatives and skills that are imperative to move science education standards forward to meet the global requirements. However, some may have the knowledge of science but lack the expertise of effective method of teaching.

❖ *Poor Working Conditions, Remuneration and Teachers' Welfare*

It is a known fact that conducive working environment for teachers directly contributes to the good quality of science education (Okoli, et al., 2013). Again, there is need for the government to rehabilitate and restore the image of science teachers by enhancing teachers' packages, housing/accommodation and utility allowances so as to retain and attract qualified teachers to teaching profession. Those teachers posted to rural areas are supposed to be receiving additional allowances in order to find the profession attractive and interesting.

❖ ***Lack of Teachers' Training and Development***

Lack of teachers' training and development is a serious threat to the sustainability objectives of science education in Nigeria. Scientific knowledge, ideas and concepts are dynamic and witnessing changes constantly, as such it is imperative for teachers to be constantly trained and re-trained so as to keep abreast with the new and emerging facts and principles. It is assumed a teacher with adequate materials, enough time and sound content knowledge still requires further training on classroom and science experimental management skills in order to provide students with an excellent science education with remarkable achievements.

❖ ***Curriculum Deficiencies***

Offorma (2005) described curriculum as a vehicle through which education takes place. Furthermore, she perceives it as involving the learner, the teacher; the content; the subject; the resources; the methods of teaching; the evaluation as well as the physical and psychological environment, which must be adequate and conducive for learning to take place. Science education curriculum is expected to equip learners with skills that will make them self-reliant, prepare them to enter into jobs and progress in them. That was why Adikwu (2008) as cited by (Christiana, 2012) stated that the problem with science education is a lack of good curriculum, that curriculum must be developed, and that there should be a readily-available inquiry-based curriculum. Furthermore, Hamidu & Mohammed (2015), reaffirmed that there are many factors that have a negative effect on curriculum implementation, it has been observed that, the nation's economy plays a vital role in as far as the implementations of the curriculum is concerned. The availability of all resources required in the education system to facilitate effective teaching and learning processes depend on the availability of funds too.

❖ ***Obsolete Teaching Methodology***

One of the qualities of a professional teacher is the use of appropriate and up to date teaching methods. It is of the common opinion that, methodology of teaching is what makes a teacher a professional. The old method only presents students as mere spectators listening to all that comes from the teachers. In order to achieve the objectives of science education, teachers should employ teaching strategies that will enable learners to develop adequate learning strategies which will eventually assist them to acquire basic knowledge, values and skills with some degree of freedom that allow learners to initiate and complete learning with minimal interference.

❖ ***Lack of Adequate Practical Exposure***

Science is an abstract course and will only be understood through the use of adequate and appropriate teaching methods. Practical work is an appropriate teaching method which can be defined as any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials. Practical work is widely and frequently used in the teaching of science in developed countries

(Bennett, 2003; Millar, 2004). A likely reason for this, as suggested, is that many science teachers see the frequent use of practical work as an essential part of what it means to be 'a science teacher'. Millar, (2004) emphasized that learning science should involve seeing, handling and manipulating real objects and materials, and that teaching science will involve acts of 'showing' as well as of 'telling'. He further added that practical work "seems the 'natural' and 'right' thing to do". Indeed, there is a common perception amongst teachers in England that the use of practical work can motivate students towards the study of science (Wellington, 2005). This means that many teachers see its use as the basic modus operandi for the teaching of science developed world.

However, the case is much different in Nigerian schools where almost every aspect of the subject is taught in theory. This presents a risk that for many teachers the use of practical work can become so routine that they cease to assess critically whether it is always the most effective way of achieving a specific learning outcome. In this regard, 'patronage' of sustainable development activities and programmes of the science education is likely to be low, except there is a sustained publicity stunt at all levels to create the level of awareness among the citizens about the importance of science education.

Improving Science Education in Nigeria for Sustainable Economic Development: The Way Forward

Larai et al. (2017) affirmed that knowledge of and about science are integral to preparing our population to be actively engaged and be responsible citizens, creative and innovative, able to work collaboratively and fully aware of and conversant with the complex challenges facing the society. They went further to say it helps us to explain and understand our world, to guide technological development and innovation and to forecast and plan for the future. This puts science education at the centre of a broader educational perspective for society as a whole. It is obvious that science educational attainment is linked to better health, personal empowerment and active engagement in public affairs and civil society being more trusting and supportive of other people, as well as feeding and housing our population, healthy living, protecting our environment, generating sufficient energy, supplying enough clean water, urbanization and global climate change. We have a much better chance of tackling these challenges if all societal actors understand the issues and their consequences and are actively involved in helping identify and monitor society's responses by working together in an inclusive participatory way, we can better align the goals and outcomes of science education and research with the values, needs and expectations.

✓ *Integrating innovation into Teaching methodology*

Methods are means that teachers use to drive home their lesson presentation thereby making learning experiences concrete to learners. Accordingly, Mbakwe (2005) as cited by Ayodeji et al., (2018), affirmed that methodology of teaching is what makes a teacher a professional. The old method only presents learners as mere spectators listening

and swallowing all that comes from the teachers. For proper achievement of the objectives of science by the learners the teachers should provide learners with basic knowledge, values and skills and with some degree of freedom allow learners to initiate and complete learning with some degree of freedom to allow learners to initiate and complete learning with minimal interference.

✓ ***Creating Awareness on Sustainable Development Issues***

Improving awareness of sustainability includes such issues as control of greenhouse gases, land and energy use, consumption patterns, pollution and transport, all of which have direct connections to education for sustainable development (Ajibade, 2013). There is a high degree of interdependence between all these factors. An understanding of these matters through education contributes to building the skills and attitudes needed to question the way we think, the values we hold and the decisions we make in the context of sustainable development. This in turn would seek to enable individuals to take informed and responsible decisions and actions on the need to take science education as the most appropriate means to achieve the sustainable development goals.

✓ ***Improving Practical Exposure to students***

As stated earlier, scientific knowledge is by nature abstract and theoretical. For students to acquire basic knowledge, values and skills for the required technological advancement, they must undergo series of practical experiences with modern and functional practical equipment that meet the global standards. Hinged on these practical experiences, students are expected to use a foundational knowledge of a scientific field as a springboard to asking and answering their own questions and proffering solutions to societal problems accordingly. This move to a more student directed approach which in turn promotes acquisition of scientific skills (David, 2009 as cited by Hamidu & Mohammed, 2015).

Practical work provides 'hands-on' experiences that promote the learning and practice of manipulative laboratory skills. Science educators and science students agree that practical work is an essential part of scientific research as well as science education.

✓ ***Engagement with Industry, Commerce and the Community***

Achieving economic sustainability in science education requires social change, which is predicated on changing public awareness. Both educators and students of science have a responsibility to articulate and disseminate new sustainability related scientific knowledge and information, including its attendant uncertainty, to society at large through various fora. For example, through roundtable discussions, conferences, seminars and dialogue between scientists and other stakeholders, including citizens and policy makers, new knowledge can be a catalyst for social innovation and effective policymaking. Conversely, this dialogue can spur further innovations in knowledge that help society progress along the path of sustainability (Ajibade, 2013).

✓ ***Remuneration and Improved Work Conditions of Science Teachers***

It is a known fact that optimal working condition for teachers directly contribute to the good quality of public education (Igbuzor, 2006). It is therefore necessary for the government to rehabilitate and restore the image of science teachers. This could be done by enhancing teachers' packages. Science teachers' housing, accommodation and utility allowances should be improved. Transfer allowances should be paid to teachers who go on transfer, and those who dwell in rural areas to perform their duties should be given special allowances to motivate them. This will give them job satisfaction and enhance their productivity.

✓ ***Conducting Research on Sustainable Development***

Institutions of science and technology can initiate different types of research (pure or action research) in specific areas that are germane to issues addressing science education for sustainable development. Such research plays an indispensable role in development, albeit a very complex and perhaps an indirect one as stated by Vessuri (2008) as cited by Ajibade, (2013). Research, apart from creating and increasing knowledge, also enhances understanding of sustainability issues and informs policy decisions.

To make its research outcomes useful and beneficial for the purpose of promoting sustainability practices, every stakeholder is expected to ensure the dissemination, transfer or sharing of its research ideas and knowledge to those who require the input of such research findings to enhance good sustainability practices especially at local or community levels.

✓ ***Inclusion of Entrepreneurship in science Education***

Again, inclusion of entrepreneurship in science education in the Nigerian Universities, Polytechnics, Colleges of Educations and Secondary Schools will enhance the output in science education. This will in turn aid economic sustainability of the nation.

✓ ***Development of Self-regulation***

Self-regulation is also referred to as self-management/self-development. Self-regulation refers to the ability of students to control, regulate, and monitor their use of various learning strategies (Zimmerman, 2000). It is the term used to describe students' abilities to manage and regulate their behaviors. Self-regulated learners set goals for their learning, and then monitor their progress and adjust their strategies toward reaching those goals. Research indicates that self-regulatory skills are extremely important in the domain of science. Science educators can support the development of self-regulation in their students in several ways. First, students must be allowed to have some control over how they learn or process science material. Self-regulation is by definition a "self" controlled process; when science curricula are tightly regulated and prescribed by the teacher (offering students little flexibility) students are unlikely to engage in self-regulatory behaviors. Second, educators must encourage students to evaluate their work

as they progress (Pintrich & Schunk, 2002). If students do not stop and reflect on whether they are reaching their goals, then they often will not attain their goals, particularly if they do not adjust their strategies when necessary.

✓ *Creating Adaptive Motivational Contexts in Science Classrooms*

There has been much research in recent years examining the role of motivational constructs in science education. In particular, research clearly indicates that the types of motivational goals, beliefs, and attitudes that students have are directly related to the ways in which students cognitively process information. Research from a goal orientation theory perspective explains the complex relations between the motivational climates created by teachers in classrooms, and students' cognitive functioning (Ames, 1992; Dweck & Leggett, 1988).

In a related study, Anderman and Young (1994) used multilevel modeling (HLM) to examine the relations between teachers' instructional practices in adolescent science classrooms and student outcomes. Results indicated that teachers' use of ability-focused instructional practices (e.g. displaying the work of the highest achieving students as examples, pointing out students who do exceptionally well in science, and giving them special privileges) was related to motivational goals and orientation.

Conclusion

The development of any nation depends directly on its level of scientific literacy. Efforts by scholars, researchers and educationists have shown the nexus between science education and sustainable development. This paper posits that Nigerians and indeed Nigeria require an effective science education in order to achieve the goals of sustainable development. This is based on the fact that development in the 21st century should be anchored on the scientific knowledge and skills in which science education plays a pivotal role.

Thus, science education if fully implemented will accelerate the sustainable development of Nigeria by providing the bedrock upon which technological advancement of the nation is built. Finally, the philosophy of science education has to be reviewed to promote modern scientific discoveries on local, national and international scale.

References

- Agbowuro, C., Oriade, L. T. & Shuaibu, S. (2015). The Nigerian Child, Science And Technology Education, Current Challenges And Possible Solutions. *International Journal of Education, Learning and Development*. 4 (1), 60-69. Published by European Centre for Research Training and Development UK (www.eajournals.org)
- Ajibade A. P. (2013). Building Human Capital for Sustainable Development: Role of the University. A paper delivered on the occasion of the 2013 University of Ibadan Registry Discourse On Thursday, 26th September.

- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84(3), 261-271.
- Anderman, E. M., & Young, A. J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching*, 31(8), 811-831.
- Ayodeji M. A. et al. (2018). Science Education in South-West Nigeria: Implication for Educational Policy. *Proceedings of the Nigerian Academy of Science Volume 11*.
- Batomalague, A. E. (2015). Basic Science Development Program of the Philippines for International Cooperation. University of San Carlos, Cebu City, Philippines. Retrieved from www.criced.tsukuba.ac.jp/pdf/09_Philippines_Antonio.pdf (Last accessed on 16th September, 2015).
- Bennett, J. (2003). Teaching and learning science: A guide to recent research and its applications. London: Continuum.
- Christiana, O. N. (2012). Revisiting Science Education and National Development: Nigerian Situation and the Way Forward. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 1(10), 1-13.
- Danjuma, D. & Adakole, I. (2019). Science Education and Sustainable Development in Nigeria: An Analytic Approach. *IOSR Journal of Humanities and Social Science (IOSR-JHSS)* 24(6), 0837-0845. www.iosrjournals.org.
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95(2), 256-273.
- Federal Republic of Nigeria (2004): "National Policy on Education". Lagos, Nigeria.
- Gabriel, O. A. (2019). Science and Technology Education Development and the Nigerian Child: Challenges and Prospects (*BSUJEM*). 1(2), 57- 66.
- Garner, N., Hayes, S. M., and Eilks, I. (2014). Linking Formal and Non-Formal Learning in Science Education – A Reflection from Two Cases in Ireland and Germany. *Sisyphus Journal of Education*, 2(2), 10-31.
- Hamidu, M. Y. & Mohammed, A. (2015). The Challenges Facing Science Education in Developing Countries and the Way Forward. *International Journal of Scientific Engineering and Research (IJSER)* www.ijser.in 3(11), 181-188.
- Hanachor, M. E. & Wordu, E. N. (2021). Achieving Sustainable Development Goal 4 in Nigeria: Problems and Prospects. *International Journal of Education, Learning and Development*. 9(2), 10-25.
- Igbaji, C., Miswaru, B. and Sadiyya, A. S. (2017). Science Education and Nigeria National Development Effort: The Missing Link *International Journal of Education and Evaluation*. 3(5). www.iiardpub.org.
- Igbuzor, O. (2009). Challenges of development in Nigeria. Lagos: Robitos Alliance Publishers.
- Ingo, E. (2014). Science Education and Education for Sustainable Development – Justifications, Models, Practices and Perspectives. *Eurasia Journal of Mathematics, Science & Technology Education*, 11(1), 149-158.

- Klaus, D. M. (2013). TVET for a Green Economy. Institute for Sustainable TVET & Management Services. BMZ Berlin Dahlmannstrasse 4 Stresemannstrasse 94 53113, Bonn 10963 Berlin Germany Germanypoststelle@bmz.bund.de www.bmz.de
- Larai, A. K, Christine, A., Christiana, S. J. & Naomi, A. G. (2017). Development of Science Education in a Globally Depressed Economy. *International Journal of Innovation and Research in Educational Sciences*. 4 (1), 35-39.
- Leicht, A., Heiss, J. and Byun, W. J. (2018). Issues and trends in Education for Sustainable Development. The United Nations Educational, Scientific and Cultural Organization, 7, place de Fontenoy, 75352 Paris 07 SP, France.
- Lewis, A. (2015). Science Teaching in Africa. London: Heineman Educational Book Ltd.
- Millar, R. (2004). The role of practical work in the teaching and learning of science. Paper prepared for the meeting: High school science laboratories: Role and vision.
- Momeke, C. O. (2007). 'Effects of the Learning Cycle and Expository Instructional Approaches on Students' Learning Outcome in Secondary Biology' An unpublished PhD thesis submitted to the school of postgraduate studies, University of Benin, Benin City.
- Nwangwu, R. (2014). Teachers for Technology: Basic Principles of School Technology Report. PATT 3 Conference, 2, 487 – 493.
- Offorma, G.C. (2005): "Curriculum for Wealth Creation". A Paper presented at the Seminar of the World Council for Curriculum and Instruction Held at the Federal College of Education, Kano.
- Ogunmade, T.O (2006). And Quality of Secondary Science Teaching and Learning of Secondary Science Teaching and Learning of Secondary in Lagos State, Nigeria. An Unpublished Doctoral Thesis, Edith Cowan University, Perth, Western Australia.
- Okebukola, P.A.O. (1997). The state of science education in Nigeria. Paper presented at the ELLSA- British Council Primary Science Forum, Kaduna, Nigeria.
- Okoli, S. O., Obiajulu, A. N. and Ella, F. A. (2013). Science Education for Sustainable Development in Nigeria: Challenges and Prospects. *Academic Journal of Interdisciplinary Studies Published by MCSER-CEMAS-Sapienza University of Rome*. (2)6.
- Omoifo, C. N. (2012). Dance of the limits – reversing the trends in science education in Nigeria. Inaugural Lecture Series 124, Benin City: University of Benin Press.
- Omorogbe, E. & Ewansiha, J. C. (2013). The Challenge of Effective Science Teaching in Nigerian Secondary Schools *Academic Journal of Interdisciplinary Studies MCSER Publishing, Rome-Italy*. 2 (7).
- Pember, S. T. & Humbe, T. T. (2009). Science Education and National Development. Being a paper presented at the ASSUTIBS Maiden National Conference at CEO Katsina-Ala 6th -9th October.
- Pintrich, P.R., & Schunk, D.H. (2002). Motivation in education: Theory, research, and applications (2nd ed.). Upper Saddle River: Merrill/Prentice Hall.

- Sinclair C. (1988). Science and Technology in Greece, Portugal and Turkey. *Science and Public Policy*, 15, 354.
- Singh, M. C. and Titi, V. (1992). Empowerment for Sustainable Development: Towards Operational Strategies. Canada. A Publication of International Institute of Sustainable Development (USD).
- UNCED (1992). United Nations Conference on Environment and Development Agenda 21: Action Plan for the Next Century United Nations. Rio de Janeiro.
- UNESCO (2000). Current challenges in basic science education. Retrieved from [www.http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf](http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf).
- UNESCO (2015). Current challenges in basic science education. Retrieved from [www.http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf](http://portal.unesdoc.unesco.org/images/0019/001914/191425e.pdf) (Last accessed on 16th September, 2015).
- Urevbu, A. O. (2001). *Methodology of Science Teaching*, Jutland Education Publishers. Lagos.
- W. E. F. (2016). World Economic Forum Global Competitiveness Report 2015-2016 <http://reports.weforum.org/global-competitiveness-report-2015-2016/education/#view/fn-53>
- Wellington (2005). *Practical work in school science: Which way now?* (pp. 3-15). London: Routledge.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. *Handbook of self-regulation* (pp. 451-502). San Diego, CA: Academic.

THE IMPACT OF SOCIAL MEDIA ON EDUCATION AND SOCIETY

Komolafe Taiwo

Department of Computer Science
Villanova Polytechnic Imesi-Ile,
Osun State, Nigeria
Komolafe.taiwo2@gmail.com

Abstract

The purpose of this article is to assess the impact of social media on education and society. Social media is a platform for people to discuss their issues and opinion. Before knowing the aspects of social media people must have to know what is social media? Social media are computer mediated technologies that facilitates the creation and sharing of information, ideas, opinion, issues, career interests and other forms of expression via virtual communities and network. Social media services are web-based services which can be used via Desktop computers, laptops, and mobile (Smartphone) & tablet computers. Using these services people can have highly interactive platform where they can also share images, videos, information's and even more with each other through a particular network. This paper presents the impact of social media on education and society with its positive and negative effect.

Keywords: *Social Media, Society, Education, Teenager*

Introduction

Social media has become a vital part of every one's life from online shopping to electronic mails, education and business tool. Social media plays a vital role in transforming people's life style. Social media includes social networking sites and blogs where people can easily connect with each other. Since the emergence of these social networking sites like Facebook, Twitter, WhatsApp and Instagram etc. These sites have become a day-to-day routine for the people. Social media is defined as "forms of electronic communication, such as websites for social networking and micro-blogging, through which users create online communities to share information, ideas, personal messages, and other content, such as videos and other various media". Social Media is a platform that lets us participate in social networking. We can share our posts on various social media platforms to improve business visibility. Today it is the best source for news updates, marketing, education, and entertainment.

1. Impact of Social Media on Education

Education is very essential part of an individual's life for every teenager education is more important than anything. Today teenager shows very much interest for using social networks but unfortunately Social Networks affect education badly.

As per the survey of previous research, 90% of college students use social networks. Technology has shown a rapid development by introducing small communication devices and we can use these small communication devices for accessing social networks any time anywhere, as these gadgets include pocket computers, laptops, iPads and even simple mobile phones (which support internet) etc. For the purpose of education social media has been used as an innovative way. Students should be taught to use this tool in a better way, in the educational classes' media just being used for messaging or texting rather than they should learn to figure out how to use these media for good. Social media has increased the quality and rate of collaboration for students. With the help of social media students can easily communicate or share information quickly with each other through various social sites like Facebook, twitter, and Instagram etc. It is also important for students to do some practical work instead of doing paper work. They can also write blogs for Teachers as well as for themselves to enhance their knowledge skills. Social networking sites also conduct online examination which plays an important role to enhance the students' knowledge.

1.1 Positive effects of social media on Education:

1. **New Skills:** Social media teaches students skills they'll need to survive in the business world. Being able to create and maintain connections to many people in many industries is an integral part of developing a career or building a business.
2. **Quality Education:** It has also increased the rate and quality of collaboration for students. They are better able to communicate with each other, share information quickly, which can increase productivity and help them learn how to work well in groups.
3. **Familiarity with new Technology:** By spending much time working with new technologies, students develop more familiarity with computers and other electronic devices. With the increased focus on technology in education and business, this will help students build skills that will aid them throughout their lives.
4. **Enhance Creativity:** The ease and speed with which users can upload pictures, videos or stories has resulted in a greater amount of sharing of creative works. Being able to get instant feedback from friends and family on their creative outlets helps students refine and develop their artistic abilities and can provide much needed confidence or help them decide what career path they may want to pursue.

1.2. Negative effects of social media on Education:

1. **Reduces Learning:** Today students rely on the accessibility of information on social media specifically and the web in general to provide answers, this can reduce focus on learning and retaining information.

2. **Poor Academic Performance:** Students, who attempt to multi-task, checking social media sites while studying, show reduced academic performance. Their ability to concentrate on the task at hand is significantly reduced by the distractions that are brought about by YouTube, Facebook or Twitter.
3. **Privacy is not maintained:** The degree to which private information is available online and the anonymity the internet seems to provide has made students forget the need to filter the information they post. Many colleges and potential employers investigate an applicant's social networking profiles before granting acceptance or interviews. Most students don't constantly evaluate the content they're publishing online, which can bring about negative consequences months or years down the road.

2. Impact of Social Media on Teenagers:

Using social media web sites is among the most common activity of today's children and adolescents. Any Web site that allows social interaction is considered a social media site, including social networking sites such as Facebook, MySpace, and Twitter; gaming sites and virtual worlds such as Club Penguin, Second Life, and the Sims; video sites such as YouTube; and blogs. Such sites offer today's youth a portal for entertainment and communication and have grown exponentially in recent years. For this reason, it is important that parents become aware of the nature of social media sites, given that not all of them are healthy environments for children and adolescents. Pediatricians are in a unique position to help families understand these sites and to encourage healthy use and urge parents to monitor for potential problems with cyber bullying, "Facebook depression," sexting, and exposure to inappropriate content.

2.1 Positive effects of social media on Teenagers:

1. **Help Develop Awareness:** Most teens live a sheltered life. But with exposure to various media outlets, they develop awareness about society and the world. This cultural and political awareness is vital if we want to groom a generation of socially responsible citizens. With news channels, magazines, social networking sites blaring about world happenings, teens can realize that there is more to the world than just what is happening in the 'hood'.
2. **Help Develop Social Skills:** Many teens are socially awkward. Media gives them the chance to groom their social skills. It also gives them the chance to expand their social circle and develop new friendships. Other benefits include social confidence, heightened literacy in the media, and more social support.
3. **Inspire Teenagers:** When a teenager watches an action flick, don't just despair about the violence. With a little guidance, they can use the movie as inspiration. Teenagers look up to celebrities, and when a celebrity tells them to stay off drugs, they just might listen.

4. **Help Fine Tune Motor Skills:** Video games draw a lot of flak these days. But there's some good in video games too! There are a few video games that can help teens develop and fine-tune their motor skills and coordination.

2.2. Negative effects of social media on Teenagers:

1. **Making Violence Normal:** The amount of violence in video games and movies today is scary. And teenagers spend several hours every day watching these scenes of gore. Violence becomes their reality. Many teenagers are unable to distinguish between reality and fantasy. This makes violence 'normal' for them.
2. **Risky Sexual Behaviour:** Teenagers are just discovering their sexuality. It is very normal for them to be interested in everything sexual. But the amount of sex in media today can make a teenager confused. Sex without responsibility – that seems to be the message being beamed at teenagers. This can lead to irresponsible sexual behaviour and unwanted pregnancies.
3. **Making Everything Commercial:** Happiness comes at a price. At least that's the message teenagers get through media. Their life would be perfect if only you'd buy them that hot new game, that happening dress. Advertisers target teenagers to ramp up their revenues. But teenagers fall prey to the idea of commercialization of happiness.
4. **Score Low In School/Colleges:** Teens who watch too much television have lower scores in exams. Also, such teens are not good readers as they spend more time in front of the television. A study reveals that individuals with high degree scores watch less television in their childhood and teenage. Another study reveals that different media affects school work differently.

3. Impacts of Social Media on Society:

Almost a quarter of the world's population is now on Facebook. In the Nigeria nearly 80% of all internet users are on this platform. Because social networks feed off interactions among people, they become more powerful as they grow. Thanks to the internet, each person with marginal views can see that he's not alone. And when these people find one another via social media, they can do things – create memes, publications and entire online worlds that bolster their worldview, and then break into the mainstream.

Without social media, social, ethical, environmental and political ills would have minimal visibility. Increased visibility of issues has shifted the balance of power from the hands of a few to the masses.

Without social media, social, ethical, environmental and political ills would have minimal visibility. Increased visibility of issues has shifted the balance of power from the hands of a few to the masses. The flipside: Social media is slowly killing real activism and replacing it with 'slack activism'. While social media activism brings an

increased awareness about societal issues, questions remain as to whether this awareness is translating into real change.

3.1. Positive effects of social media on society:

1. **Connectivity:** The first and main advantage of the social media is connectivity. People from anywhere can connect with anyone. Regardless of the location and religion. The beauty of social media is that you can connect with anyone to learn and share your thoughts.
2. **Help:** You can share your issues with the community to get help and giddiness. Whether it is helping in term of money or in term of advice, you can get it from the community you are connected with.
3. **Information and Updates:** The main advantage of the social media is that you update yourself from the latest happenings around in the world. Most of the time, Television and print media these days are biased and does not convey the true message. With the help of social media you can get the facts and true information by doing some research.
4. **Noble Cause:** Social media can also be used for the noble causes. For example, to promote an NGO, social welfare activities and donations for the needy people. People are using social media for donation for needy people and it can be a quick way to help such people.

3.2 Negative effects of social media on society:

1. **Cyber bullying:** According to a report published by PewCenter.org most of the children have become victims of the cyber bullying over the past. Since anyone can create a fake account and do anything without being traced, it has become quite easy for anyone to bully on the Internet. Threats, intimidation messages and rumours can be sent to the masses to create discomfort and chaos in the society.
Hacking: Personal data and privacy can easily be hacked and shared on the Internet. This can make financial losses and loss to personal life. Similarly, identity theft is another issue that can give financial losses to anyone by hacking their personal accounts. Several personal twitter and Facebook accounts have been hacked in the past and the hacker had posted materials that have affected the individual's personal lives. This is one of the dangerous disadvantages of the social media and every user is advised to keep their personal data and accounts safe to avoid such accidents.
3. **Addiction:** The addictive part of the social media is very bad and can disturb personal lives as well. The teenagers are the most affected by the addiction of the social media. They get involved very extensively and are eventually cut off from the society. It can also waste individual time that could have been utilized by productive tasks and activities.

4. **Reputation:** Social media can easily ruin someone's reputation just by creating a false story and spreading across the social media. Similarly businesses can also suffer losses due to bad reputation being conveyed over the social media.

4. Conclusion

The world is getting closer every day and everyone wants to be connected. Static blogs and websites are losing popularity. World is moving more towards "information streams". The information comes to users rather than users have to make effort to get the information. It has become routine for every person and with these people are getting addicted with the technology. Social Media has affected various fields in both Positive as well as Negative aspects. The current research shows that in Education field students can get the quality of education, acquire new skills but at the same time he/she may get distracted and addicted by too much use of social media. Social media has helped Teenagers in developing awareness, develop social skills, but has also made violence normal, made everything commercial and also many teenagers are not able to score good in their exams. We can say that social media is a boon for Industries in many ways by fostering information on websites, emails, social networking etc, business can be promoted via Facebook fan following, advertising. In Social media helps Society in connecting each other, provides updated information, helps in social welfare activities etc. at the same time there are many negative effects such as Cyber bullying, Hacking, Addiction of Facebook, Twitter, You tube. So the use of social media has many Positive aspects but it should be used in a limited way without getting addicted.

References

1. <https://www.techbead.com/positive-and-negative-effects-of-social-media-on-society/>
2. <http://www.edudemic.com/social-media-education/>
3. S. Kuppuswamy, P. B. Shankar Narayan, "The Impact of Social Networking Websites on the Education of Youth", In International Journal of Virtual Communities and Social Networking,
4. <http://viralms.com/blog/2011/04/how-social-media-affects-students/>.
5. http://www.momjunction.com/articles/positive-and-negative-influences-of-media-on-teenagers_00107975/#gref
6. <https://www.techmaish.com/advantages-and-disadvantages-of-social-media-for-society/>
7. <https://hubpages.com/technology/effects-of-social-media-on-our-youth>
8. <http://www.bbcactive.com/BBCActiveIdeasandResources/Howsocialmediaischangingeducation.aspx>

9. Gitanjali Kalia Chitkara University, Punjab, A Research Paper on Social media: An Innovative Educational Tool, Issues and Ideas in Education Vol.1 March 2013 pp. 43-5
10. <http://www.automatedbuildings.com/news/sep11/columns/110826030404mandrusiak.html>.
11. https://en.wikipedia.org/wiki/Social_media#References.

ALGORITHM AND FLOWCHART: TWIN BROTHERS AS TOOLS FOR OPTIMIZATION

Yusuf, Abdulkawiyu K.^{1*}
Abdul-Hameed, Taofeek A.² &
Tijani, Oluwafemi M.²

¹Department of Electrical and Electronics Engineering, Villanova Polytechnic, Imesi-ile, Imesi-ile, Osun State, Nigeria.

²Department of Electrical and Electronics Engineering, Federal Polytechnic, Ede, Ede, Osun State, Nigeria.

E-mail: engryusufak@gmail.com

Abstract:

A step-by-step procedure structured in achieving a defined objective or objectives within a specific time frame is known as an algorithm. Two or more of such steps may repeat (looping) itself once or more in order to achieve the set objective or objectives. Flowcharts are schematic representations of algorithms. Optimization is the scientific method of getting the best considered suitable alternative out of several possible alternatives. Minimization of efforts or costs or maximization of benefits or profits is the central goal of optimization. Algorithm and flowchart can be viewed as tools for optimization. Both can be used to predict the performances of parameters within one or more objective functions when subjected to one or more possible constraints. Minimization of harmonics in a power distribution network through the use of five different filters is used to illustrate the beauty of algorithm and flowchart in an optimization problem in this work. An algorithm is formulated and a flowchart developed. A template that can be adopted by researchers studying the effects of harmonics and how to mitigate such is finally developed.

Keywords: Algorithm, Distribution, Filters, Flowcharts, Harmonics, Mitigation, Network, Optimization, Power.

1.0 Introduction

Algorithm has been extensively used in solving many optimizations related problems [1 – 3]. Many algorithm techniques to solve optimization problems exist in the literature. All are structured step-by-step method aimed in minimizing cost or maximizing benefits. Flowchart in its simplest form is a mere diagrammatic representation in whatever form of a step-by-step processes of achieving an aim or realizing an objective. The aim or objective can be either minimizing cost or maximizing benefits when applied to optimization of a resource, item, good, product or service. Thus, the duo of algorithm and flowchart can be regarded as identical twin brothers that greatly assist in solving an optimization problem.

Electric Power Quality (EPQ) refers to the ability of an electrical network to maintain near sinusoidal waveform of power distribution bus voltages and currents at rated magnitude and frequency. Voltage, current or frequency deviations results in low power quality with its several disadvantages [4].

Harmonics is a major factor in defining power quality. A harmonic is a signal whose frequency is an integral multiple of the frequency of some reference signal and a greater percentage of electric signals contain energy at the fundamental and harmonic frequencies. Harmonics are usually caused by the behavior of nonlinear loads [5 - 12].

The voltage supplied by a distribution network and other loads supplied from a network with induction furnace will be negatively affected if necessary precautions and corrective measures are not taken to control the harmonics generated by the furnace [13 - 19].

There are many disadvantages posed by current harmonics to electrical network. The flow of harmonic currents through the system impedances in turn causes voltage distortion in the distribution system. These harmonic currents stress the electrical network, potentially damage equipment, and disrupt normal operation of devices and increases operating costs. It further causes overheating of electrical equipment and devices such as transformers, motors and cables, thermal tripping of protective devices, logic faults of digital devices, etc. [8]

Harmonic mitigation requires taking action to minimize the presence of harmonics in electrical system to avoid one or more of the disadvantages. Harmonic mitigation is carried out with the aid of electronic filter circuits which perform signal functions, specifically to remove unwanted frequency components from the signal, and to enhance wanted ones or both. Minimization of harmonics in a power distribution network can be carried out through the use of power filter which is an electronic component that effectively reduces electromagnetic interference in power line of any equipment. [13, 15, 19]

Power Filters are broadly classified into three categories. These are passive, active and hybrid filters. A passive filter uses passive components like resistor, inductor and capacitor to generate a signal of a particular band. An active filter is a type of analog circuit implementing an electronic filter using active components such as transistors, op-amps, etc. Active power filters are used to filter out both higher and lower order harmonics in a power system. [20]

While passive filters consume the energy of a signal without power gain the active filters have a power gain. Active filters require an external power supply, while passive filters operate only on the signal input. The passive circuit performs basic filtering action at the dominant harmonic frequencies (e.g., 5th or 7th) whereas the active elements, through precise control, mitigate higher harmonics. This will effectively reduce the overall size and cost of active filtering. [21]

The hybrid filters combine a number of passive and/or active filters and their structure may be of series or parallel topology or a combination of the two. They can be

installed in single-phase, three-phase three-wire, and three-phase four-wire distorted systems. [22]

There exist different classifications of active and hybrid filters based on power rating, supply system (e.g., number of wires and phases), topology (e.g., shunt and/or series connection), number of (passive and active) elements, speed of response, power circuit configuration, system parameter(s) to be compensated, control approach, and reference-signal estimation technique. [22]

In this work, the five filters considered are classified on the basis of topology. The intent is to develop a template for the minimization of harmonics in a power distribution network through the application of algorithm and flowchart to different filter topologies.

2.0 A Brief Survey of the Literature on Harmonics

Authors in [23] designed a filter that yield the required level of harmonic distortion in steel plant with induction furnaces by carrying out the simulation of an active filter for the reduction of the voltage total harmonic distortion created by a steel plant. Harmonics analysis obtained shows limitation to industrial furnaces only while other harmonics sources were neglected. Broad categorization of different harmonics mitigation techniques was applied in [24] and [25] to power distribution networks.

Based on viability and economic factors, in [26] Hybrid Harmonic Filters (HHF) was discovered to be much more attractive in harmonic filtering than other pure filters. Specific attention was not paid to high-power applications while light and heavy current scenarios were neglected. This neglect was considered in [27] by using real time method of monitoring the harmonics for both light current and heavy current industries. The study used software to analyze the presence of harmonics in the system. An extensive harmonic measurement of a real distribution system were performed in [27] to prove the usefulness of the indices for harmonic distortion monitoring of power in distribution lines but it failed to give consideration to high harmonic generating equipment.

In the mitigation of harmonics of high-power converters [28], an optimal selective harmonic mitigation method was introduced for cascaded H-bridge converter but it has the shortcoming of not being suitable for fast switching loads such as induction furnace. In addition, IEEE 519 - 1992 Standard was not given consideration.

Harmonic analysis in the time domain was conducted by authors in [29] to accurately represent the system nonlinearity and voltage dependency by using a designed hybrid reactance one-port compensator to reduce the harmonic distortion in practical single-phase and balanced three-phase distribution systems having different types of nonlinear loads. Comparative analysis of the iterative method to other active methods was conducted. The lack in comparative analysis of the iterative method to other active methods resulted in the inability to establish the most superior method. The study was not able to consider frequency domain and the use of fast switching devices such as Insulated Gate Bipolar Transistor, IGBT.

The authors in [30] postulated power system harmonics as one of the important indices to rate power quality. A comparative analysis of original hypothetical signal and reconstructed signal using the new versatile Least Mean Square, LMS algorithm was carried out. A mismatch in phase information which occurred during initialization process is a major limitation to the method.

The use of Multiple Active Power Filter Configuration in [31] proved to be a better detailed procedure for harmonic voltage mitigation in which optimum controller parameters of Active Power Filters (APFs) were calculated. The improvement in the efficiency of the installed APF was achieved by the establishment of additional APF at a proper place of the power system.

In all the above cited literatures and many more that are not cited, the processes, procedures, steps and actions taken to control, minimize or mitigate harmonics can be developed or represented in forms of algorithm and flowcharts. Development of a typical template for the processes, steps and actions involved in the mitigation of harmonics through the use of algorithm and flowcharts is the objective of this presentation.

3.0 Methodology

Step by step approaches to be adopted in achieving the aim of this study are:

- i. Preliminary studies and a comprehensive review of the literature.
- ii. Characterization of different types of harmonic mitigation techniques on the basis of circuits, devices and systems employed in the method of mitigation.
- iii. Development of a single line diagram for the case Study-Distribution Network.
- iv. Designing of the circuit and development of a Simulink Model for a simple nonlinear load.
- v. Designing of the equivalent circuit diagram of the Distribution Network with the simple nonlinear load and the development of a corresponding Simulink Model.
- vi. Establishing if harmonics is introduced into the Distribution Network by the nonlinear load through the waveforms and Fast Fourier Transform analysis from the MATLAB/Simulink Models. If harmonics exists:
- vii. Designing of a Passive and an Active Filter Circuits and the development of their corresponding Simulink Models.
- viii. Designing of the three configuration types of Hybrid Filter Circuits through a combination of the passive and active filter circuits in three different topologies and the development of their corresponding Simulink Models.
- ix. Validating the efficacy and efficiency of each filtering circuits on the Distribution Network.
- x. Designing of equivalent circuit and development of a complete Simulink Model of the Distribution Network with a Steel Plant.
- xi. Establishing the extent of harmonics introduced into the Distribution Network by the steel plant (non-linear load) through the waveforms and Fast Fourier Transform analysis from the MATLAB/Simulink Models.

- xii. Developing and building the prototype of the best power filter among the Hybrid Active Power Filter (HAPF) i.e. the Filter that control best or minimize the presence of harmonics on the Distribution Network.

The above steps simply constitute the “Algorithm”.

A flow chart representation of the Algorithm is as illustrated in Figure 1.

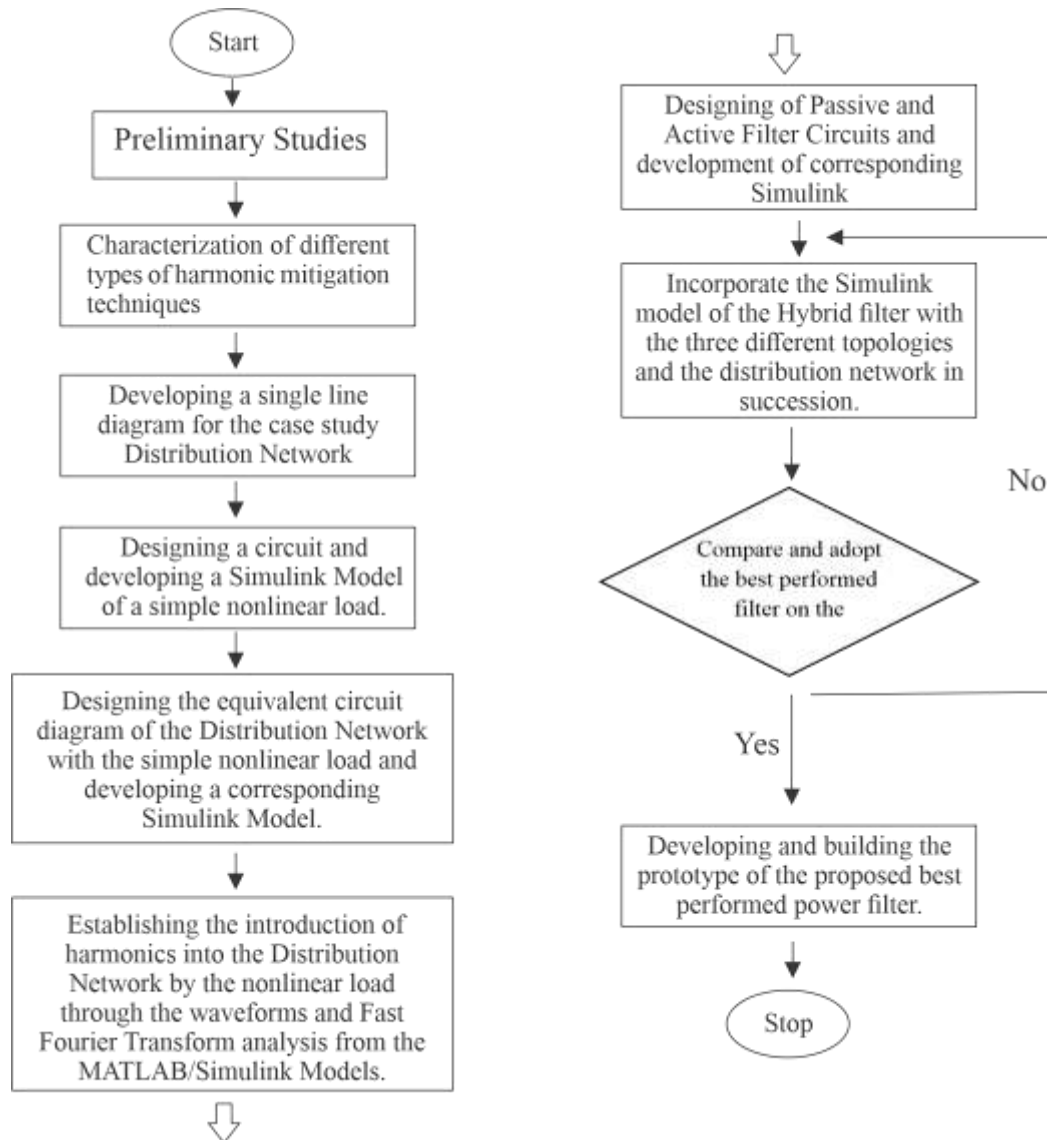


Figure 1: Flowchart of the harmonic mitigation processes of a typical distribution network.

4.0 Validation and Results from a Case Study Distribution Network

The above template was validated on a Distribution Network whose single line diagram is shown in Figure 2 and the Fast Fourier Transform Analysis for the Filters are as in Figures to 8.

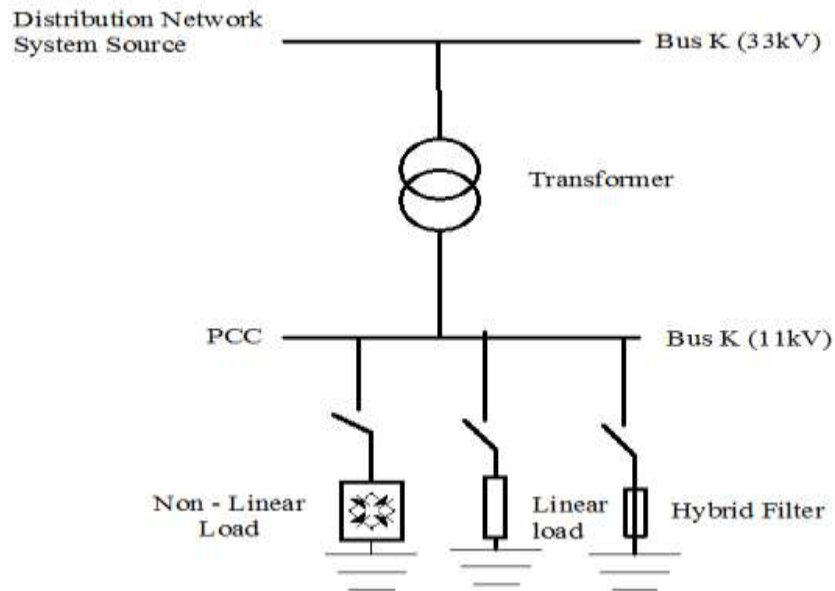


Figure 2: A single line diagram of the case study distribution network.

PCC: Point of central connection

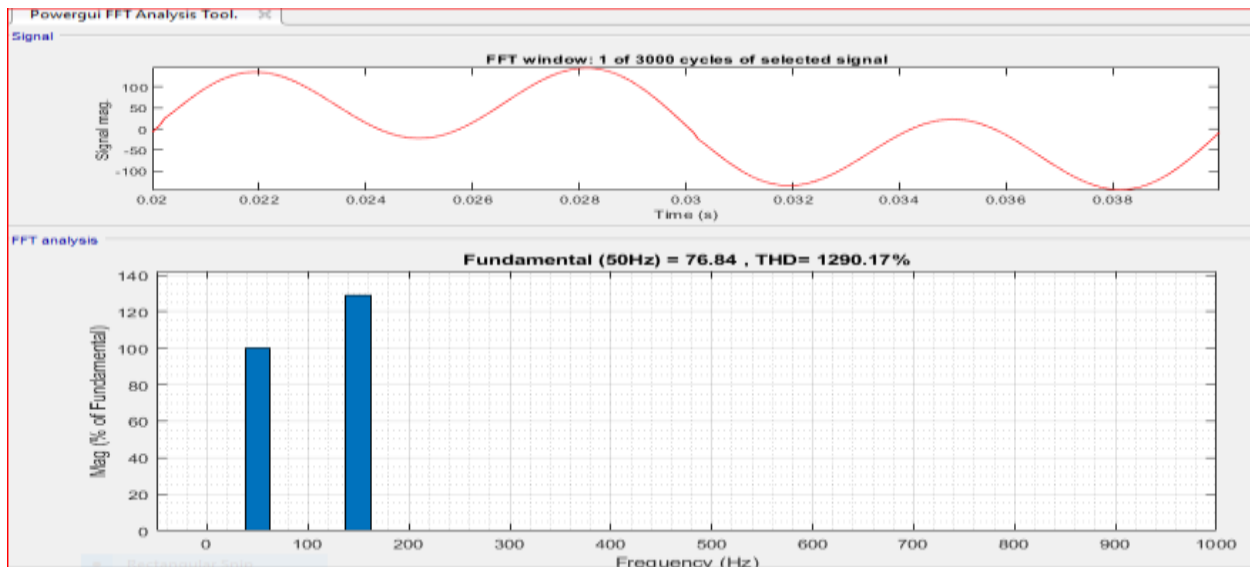


Figure 3: Fast Fourier Transform (FFT) Analysis of Load Current at the PCC without any Filter.

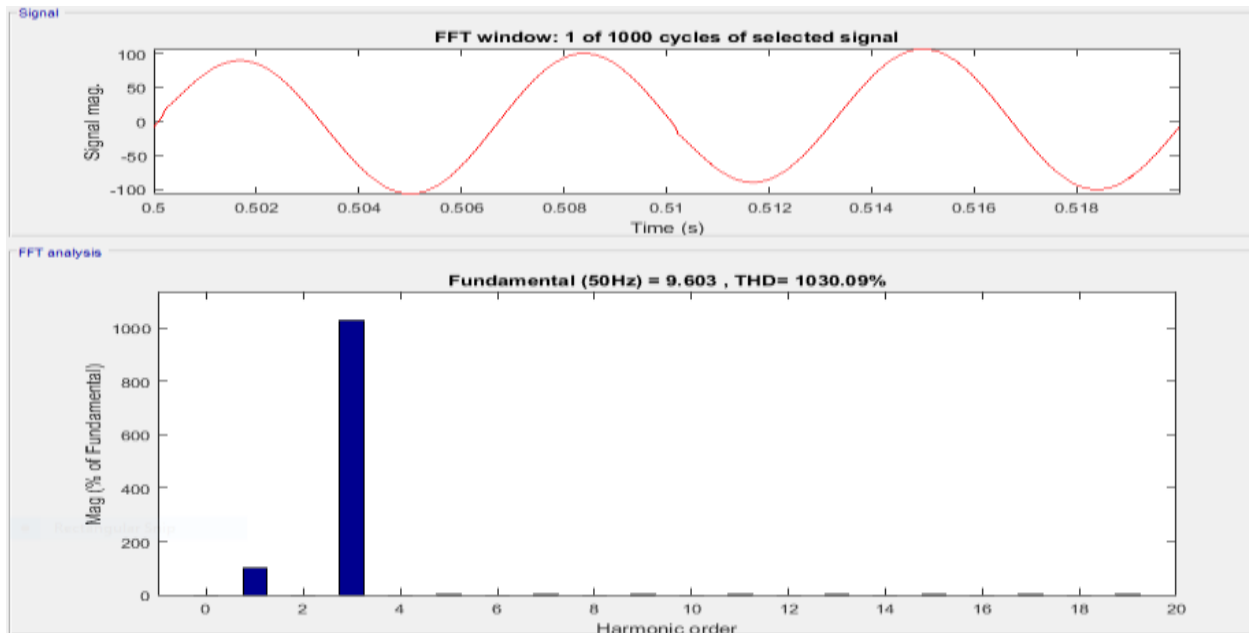


Figure 4: Fast Fourier Transform (FFT) Analysis of Load Current with the introduction of Passive Filter.

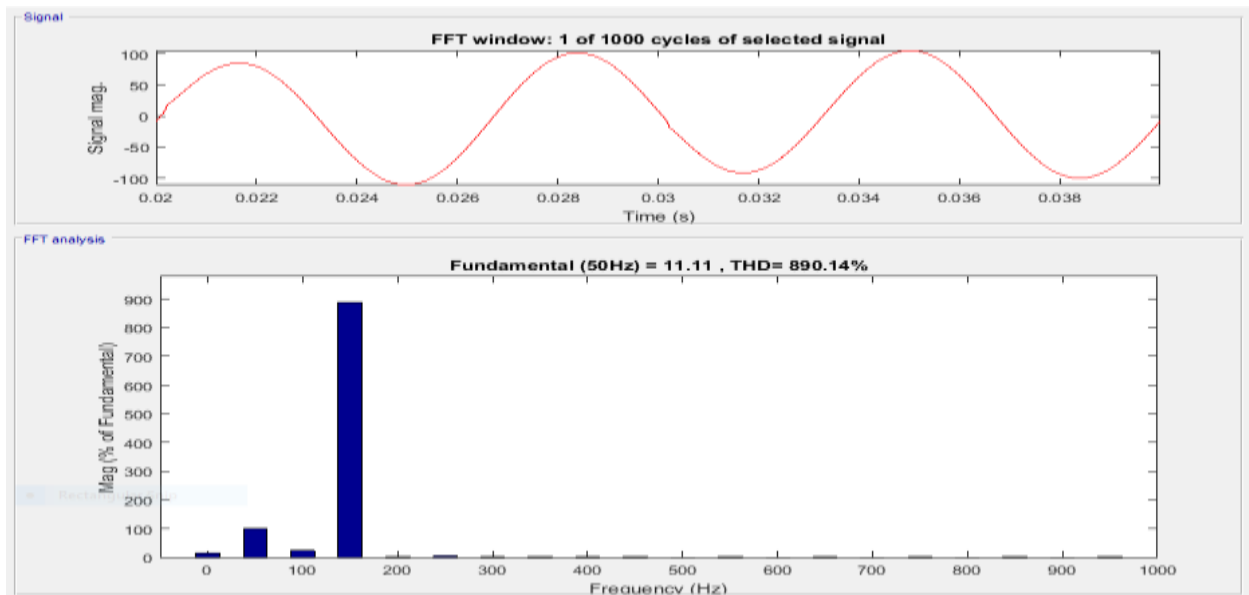


Figure 5: Fast Fourier Transform (FFT) Analysis of Load Current with the introduction of Shunt Active Power Filter.

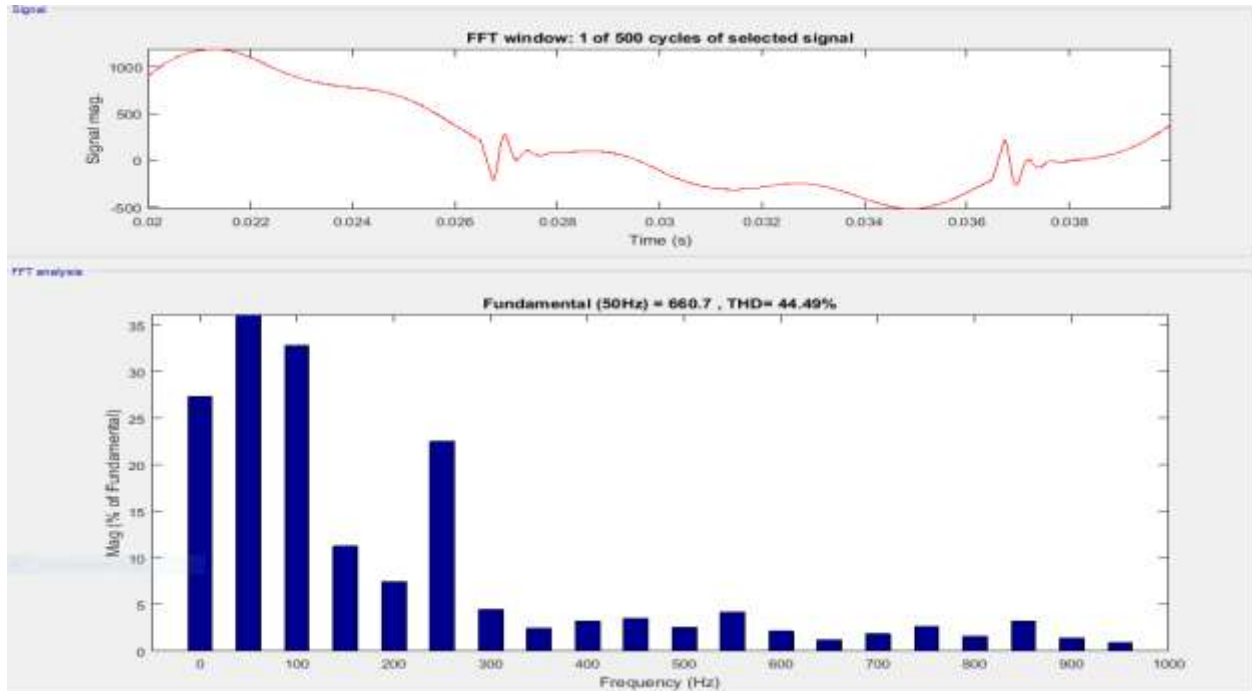


Figure 6: FFT analysis of Load Current with the introduction of Hybrid Filter Type I (Combination of a shunt active and shunt passive filter).

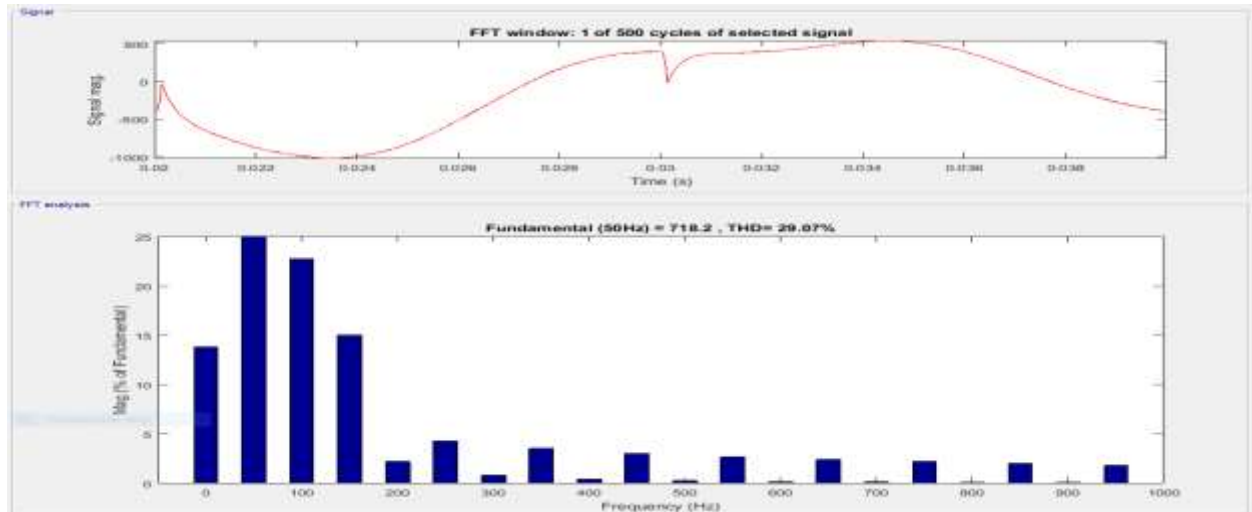


Figure 7: FFT of the distribution network after introducing Hybrid Filter Type II (Combination of a shunt active and series passive filter)

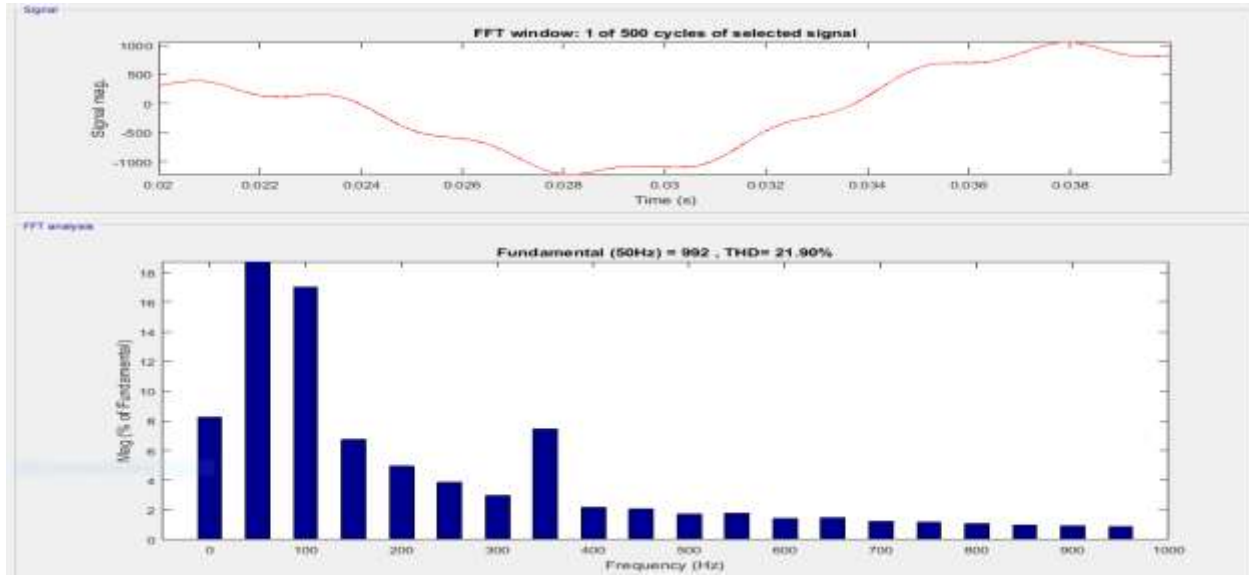


Figure 8: FFT analysis of Load Current with the introduction of Hybrid Filter Type III (Active filter is in series with passive filter).

5.0 Conclusion

A template was developed for the minimization of harmonics in this work. Using different filter configurations, the template was validated on a distribution network. The FFT analyses indicated the Total Current Harmonics Distortion (THDI) as: 1030.09%, 890.14%, 44.49%, 29.07% and 21.90% for passive, active, hybrid type I, hybrid type II and hybrid type III respectively. Thus, the hybrid filter type III performs better than others.

References

- [1] P. Garanayak and G. Panda, "Harmonic Elimination and Reactive Power Compensation with a Novel Control Algorithm based Active Power Filter," *Journal of power electronics*, Vol. 15, No. 6, pp. 1619-1627, 2015.
- [2] A. Mohammadzadeh, J. Sadati, and B. Rezaie, "Harmonic Components Estimation in Power System using Bacterial Foraging Optimization Algorithm and Stochastic Gradient Algorithm with Variable Forgetting Factor", *International Islamic University of Malaysia Engineering Journal (IIUMEJ)*, vol. 17, no. 1, pp. 127-146, 2016.
- [3] A. Sultana and C. Jambotkar, "Genetic Algorithm based Elimination of Harmonics in Three Phase Inverter", *International Journal for Science and Advance Research in Technology (IJSART)*, Volume 4, Issue 10, pp. 23 – 239, 2018.
- [4] R. A. Shaikh, A. B. Lashari and I. Ansari, "Harmonics Analysis and Mitigation Using Passive Filters" B.Sc. thesis, Department of Electrical Engineering, Mehran University of Engineering and Technology, Jamshoro, 2015.

- [5] M. S. Azam, F. Tu and K. R. Pattipani, "A Dependency Model Based Approach For Identifying And Evaluating Power Quality Problems," *IEEE Transactions On Power Delivery*, Vol.19, No.3, pp.1154 – 1166, July 2004.
- [6] M. Rouse, "Harmonics," 2005. Available online: <http://whatis.techtarget.com/definition/harmonic>. [Accessed February 15th, 2016].
- [7] J. Parmar, "Harmonics and its Effects", 2011 [Online]. Available: <https://electricalnotes.wordpress.com/2011/03/20/harmonics-and-its-effects> [Accessed May 16th, 2016]
- [8] K. G. Jackson, *Dictionary of Electrical Engineering*, Newness Butterworth, London, U.K., 1973.
- [9] R. Ingale, "Harmonic Analysis Using FFT and STFT," *International Journal of Signal Processing, Image Processing and Pattern Recognition*, Vol.7, No. 4, pp.345-362, 2014.
- [10] Scheidner Electric Company, "AccuSine Harmonic Filtering and Reactive Power Compensation Manual," 2013. [Online]. Available: <http://www.eschneider.pl/download/2013.pdf> [Accessed May 11th 2016]
- [11] Mirus International, "Harmonic Mitigating Transformers," 2003. Available online: <http://www.mirusinternational.com/downloads/hmtfaq01.pdf> [Accessed May 11th 2016].
- [12] Scheidner Electric Company, "Active Harmonic Filtering Solutions Catalogue 2009," 2009, [Online]. Available: <http://www.eschneider.pl/download.pdf>. [Accessed May 16th, 2016].
- [13] I. Zamora, I. Albizu, A. J. Mazon, K. J. Sagastabeitia and E. Fernandez, "Harmonic Distortion in a Steel Plant with Induction Furnaces," in *Proceedings of International Conference on Renewable Energies and Power Quality*, Department of Electrical Engineering, University of the Basque Country, Alda, pp. 1-7, 2003.
- [14] F. De La Rosa, "Harmonics and Power Systems," CRC Press Taylor and Francis Group, New York, 2001.
- [15] S. L. Gbadamosi and A. O. Melodi, "Harmonic Distortion from Induction Furnace Loads in a Steel Production Plant," *Network and Complex Systems*, Vol. 3, Issue 10, pp. 8-17, 2013.
- [16] M. T. Bishop, J. F. Witte and R.B. Morgan, "Steel Mill Tackles Power Quality and Power Factor Problems," *Electrical Construction and Maintenance*, Sep. 1, 1996. Available online: <http://ecmweb.com/content/steel-mill-tackles-power-quality-and-power-factor-problems> [Accessed May 23, 2016].
- [17] M. S. Lalli and I. P. S. Paul, "Field Measurement of Power Quality in Steel Rolling Mills," in *IEEE Power Quality Conference*, Hyderabad, India, pp. 279 – 282, 1998.
- [18] A. J. V. Miller, "Power System Harmonic Monitoring", Ph. D dissertation, Dept. of Electrical and Electronic Engineering, University of Canterbury, Christchurch, New Zealand, 1992.
- [19] G. Eduful, E. A. Jackson and J. E. Cole "Harmonic Emission Limits and Selecting PCC Location Based on the Type of Distribution System," *Proceedings of the World Congress on Engineering*, Vol.1, pp. 301 – 306, London, U.K., July 2 – 4, 2014 .
- [20] H. Akagi, "Modern Active Filters and Traditional Passive Filters", *Bulletin of the Polish Academy of Technical Sciences*, Vol. 54, No. 3, pp. 255-269, 2006.

- [21] H. A. Kazem, "Harmonic Mitigation Techniques Applied to Power Distribution Networks," *Advances in Power Electronics*, 2013.
- [22] B. Singh, K. Al-Haddad and A. Chandra, "Review of Active Filters for Power Quality Improvement," *Industrial Electronics, IEEE Transactions* Vol. 46, pp. 960 – 971, 1999.
- [23] I. Zamora, I. Albizu, A. J. Mazon, K. J. Sagastabeitia, E. Fernandez, "Harmonic Distortion in a Steel Plant with Induction Furnaces," Department of Electrical Engineering, University of the Basque Country Alda.
- [24] I. I. Mujawar, D. R. Patil and I. I. Mujawar, "Reactive Power Compensation and Harmonic Mitigation of Distribution System using SAPF Compensator," *International Journal of Engineering Science and Innovative Technology (IJESIT)*, Vol. 2, Issue 3, pp .494 – 502, 2013.
- [25] H.H. Kulkarnia , D.G. Bharadwaj, " Online Harmonic Monitoring, Assessment and Control with AMR on Smartphone," *Procedia Computer Science*, 4th International Conference on Eco-friendly Computing and Communication Systems, Available online at www.sciencedirect.com, ICECCS 2016.
- [26] A. Marzoughi, H. Imaneini, A. Moeini, "An Optimal Selective Harmonic Mitigation Technique for High Power Converters," *Electrical Power and Energy Systems*, Elsevier, Vol. 49, pp.34–39, 2013.
- [27] S. Vlahinic, D. Brnobic, N. Stojkovic, "Indices for Harmonic Distortion Monitoring of Power Distribution Systems," *Instrumentation and Measurement Technology Conference Proceedings, IMTC IEEE* pp. 12-15, May 2008.
- [28] E.F. El-Saadany, M. M. A. Salama and A. Y. Chikhani, "Reduction of Voltage and Current Distortion in Distribution Systems with Nonlinear Loads using Hybrid Passive Filters," *IEEE Proceedings in Generation, Transmission and Distribution*, Vol. 145, No. 3, pp. 320-328, May 1998.
- [29] H.H. Kulkarni and D.G. Bharadwaj, "Online Harmonic Monitoring, Assessment and Control with AMR on Smartphone," *Procedia Computer Science* 70, Elsevier, pp. 92 – 98, 2016.
- [30] T. Manmek, C. Grantham, B. T. Phung and W. Ngamkham, "New Efficient Algorithm for Real Time Harmonics Measurement in Power Systems 2003," www.ecti-thailand.org/assets/papers/968_pub_32.pdf[Accessed May 25th, 2016]
- [31] J. Tlustý and V. Valoucht, "Harmonic Voltage Mitigation in Industrial Power Systems by Using Multiple Active Power Filter Configuration," *12th International Power Electronics and Motion Control Conference*, pp. 580-584, February 2009.

DEVELOPMENT OF A STRATEGIC HOSPITAL INFORMATION MANAGEMENT SYSTEM

^{*1}Odeniyi O. A.,

²Akinwumi A. R.,

³Makinde B. A. &

⁴Oyeniran O. R.

^{1,2,3} Department of Computer Science, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

⁴Department of Electrical & Electronic Engineering, Osun State College of Technology, Esa-Oke, Osun State, Nigeria

*Corresponding author E-mail: olufemiodeniyi@gmail.com;
odeniyioa@oscotechesaoke.edu.ng;

Abstract

Wide spread use of information system in the delivery of managed healthcare and challenges of identifying and disseminating relevant healthcare information, complex and diverse data and knowledge forms and tasks coupled with the prevalence of legacy systems require automated approaches for effective and efficient utilization of massive amount of data to support in strategic planning and decision-making and assist the strategic management mechanisms. Despite the fact that data mining is progressively used in information systems as a technology to support analytical decision making, it is however still barely used in hospital information system to support analytical decision-making process. Hence, this paper presents the development of a web-based Strategic Hospital Information Management System (SHIMS) based on data mining technology. The designed web-based SHIMS was developed using Hypertext Protocol (PHP) as the programming language, Microsoft SQL Server 2008 as the database server and Apache as web server, and implemented using three-tier architecture. The developed SHIMS offered capabilities to increase the productivity of medical personnel, analyze care outcomes, lower healthcare costs, improve healthcare quality by using fast and better clinical decision making and generally assist the strategic management mechanisms.

Keywords: Data Mining, Information System, Health Information System, Hospital Information System, Decision Making, Strategic Management.

1. Introduction

For years, many industries have turned to information systems (IS) as a means of obtaining competitive edge; the health industry is no exception. In fact, improving health

information systems is one of the prime agendas in most health reform activities throughout the world (Abraham et al., 2011; Buntin et al., 2011; Health Information and Management Systems Society 2008; Novak and Judah 2011). The goal of health information systems is to deliver efficient patient care and quality services (Haux 2004). Health Information Systems, otherwise known as Health Informatics, is a discipline that combines information science, computer science and healthcare study. It covers all aspects of healthcare, such as nursing, dentistry, hospital and other healthcare related services. Hospital Information Systems (HIS) was chosen to limit the scope of the study; moreover, HIS as an instance of health information systems with the hospital as the healthcare environment (Haux 2006). As the name implies, this type of information systems was designed to manage hospital services like medical, administrative, financial and others.

The importance of strategic management information system in the delivery of managed healthcare can hardly be overemphasized (Hampshire and Rosborough, 1993). A variety of strategic management information system capabilities will be necessary to increase the productivity of medical personnel, analyze care outcomes, and continually refine care delivery processes to remain profitable while holding the line on costs and maintaining quality of care (Dutta and Heda, 2000).

HIS is faced with the challenges of identifying and disseminating relevant healthcare information (Sakthimurugan and Poonkuzhali, 2012), complex and diverse data and knowledge forms and tasks (Prins and Stegwee, 2000; Sheng, 2000), the lack of standardized terminology compared to basic sciences, the stringent performance and accuracy requirements and the prevalence of legacy systems (Sheng, 2000). A lot of information which is hidden in the legacy systems cannot be easily be extracted, because legacy systems are not build to answer questions that are unpredictable,

There is also a critical need for automated approaches for effective and efficient utilization of massive amount of data to support corporate and individuals in strategic planning and decision-making. Hence, many strategic management information system models and relevant systems are still being developed in order to assist the strategic management mechanisms of organizations.

Healthcare industry (hospitals) today generates large amounts of complex data about patients, hospitals resources, disease diagnosis, electronic patient records, medical devices among others (Aggarwal et al., 2012), this makes extracting hidden knowledge from medical database complex and more time consuming. Analyzing these data is critical for medical decision makers and managers, but few tools exist in the healthcare setting to analyze the data fully to determine the best practices and the most effective treatments (AlZoubi, 2013; Shaker et al., 2013).

The large amounts of data is a key resource to be processed and analyzed for knowledge extraction that enables support for cost-savings and decision making. Shaker et al (2013) noted that clinical decisions are often made based on doctors' intuition and experience rather than on the knowledge rich data hidden in the database. This practice

leads to unwanted biases, errors and excessive medical costs which affects the quality of service provided to patients.

The literature review reveals that Data Mining (DM) is progressively used in Information Systems (IS) as a technology to support decision making on the tactical level, as well as to enable decision activities within operational business processes. It is predominantly used to support analytical decision making, which is typically based on models acquired from a huge quantities of data and therefore makes possible to acquire patterns and knowledge (Rupnik et al., 2007; Rupnik and Jaklic, 2009).

In general, there are three categories of business decision making approaches: (i) decision making based on precisely defined business rules, (ii) analytical decision making based on the analysis of information and (iii) decision making based on intuition. In many cases all these three categories are used at a time. Business rule based decision making is typical for operational business processes, whereas other two are typical for managerial processes (Rupnik and Jaklic, 2009).

The use of DM to facilitate decision support enables new approaches to problem solving by discovering patterns and relationships hidden in data and therefore enabling an inductive approach to decision making. In addition, the decision to collaborate DM and decision making is also based on the fact that the traditional use of DM through its software tools does not bring it closer to business users due to the complexity of DM tools. The tools are very complex and needs expertise in DM technology. In the other words, understanding the DM algorithms and parameters for implementing in a large data set is a great task (Bawden, 2005; Lavrac et al., 2003).

In the integrating approach (collaborating DM and decision making), knowledge is automatically extracted from a large amount of row data by employing DM technologies, structured and transformed into appropriate forms, and finally retrieved by a hybrid reasoning engine in order to provide decision support for decision makings in special situations (Khademolqorani and Hamadani, 2013).

In recent years, data mining has been used in all kinds of areas of science and engineering, for instance in bioinformatics, genetics, medicine and electrical power engineering. Also people from business find more and more applications for data mining, most applications are found in finance and insurance, retail, telecommunication and security (Seng and Chen, 2010).

In the healthcare sector data mining application is however still barely used. This is odd as in these environments traditional HIS called legacy systems are used. A lot of information is hidden in the legacy systems which can easily be extracted. Most of the times this cannot be done directly from the legacy systems, because these are not build to answer questions that are unpredictable. Most healthcare institutions lack the appropriate information systems to produce reliable reports with respect to other information than purely financial and volume related statements (Prins and Stegwee, 2000).

Modern HIS gather and centrally store large amounts of data and therefore DM seems to be a good technology to support the data processing, information retrieval and

knowledge generation process in order to support decision making. DM brings a set of tools and techniques that can be applied to this processed data to discover hidden patterns. It provides healthcare professionals an additional source of knowledge for making decisions.

In the turmoil between costs, care-results and patient satisfaction the right balance is needed and can be found in collaborating DM and decision making within HIS. Research shows that successful decision systems enriched with analytical solutions are necessary for HIS (Zuckerman and Alan, 2006; Armoni, 2002; Rada, 2002). This could reduce medical errors, enhance patient safety, decrease unwanted practice variation, and improve patient outcome.

There are several algorithms and methods to mine medical/clinical data which are implemented in HIS. Using these methods have often resulted in surprising improvements in clinical decision-making. These algorithms or methods could be implemented in separate software environments (such as WEKA and IBM SPSS Modeler) and results imported to HIS, or designed as a part within HIS software engine.

Some recent technology achievements, such as SQL Server 2008 Analysis Services enables the possibility to develop application systems which utilize data mining methods and as such do not demand expertise in data mining technology for business users. The SQL Server 2008 Analysis Services which is an add-in for the widely used Microsoft SQL Server 2008 software has several benefits over traditional data mining applications (MacLennan et al., 2008). These include: ease of use, a simple but rich API and scalability (ability to handle large data sets), analysts do not have to build sample sets and the algorithms operate on the whole data set to provide the best results (Wang, 2010).

As evident from the discussion above, the classical data mining methodologies have to be extended for the cases where DM is deployed in HIS to support analytical decision making process. Hence, this paper presents the development of such a web-based HIS enriched with analytical solutions, called SHIMS. The rest of this paper is organized as following: Section 2 presents the background material on which the proposed methodology is based. Section 3 displays the methodology adopted to complete the proposed work. Section 4 shows the results of the proposed work, and Section 5 concludes the paper.

2. Background

In this section we briefly introduce areas that are important for the mission of the paper.

2.1 Data Mining

Data Mining (DM) fondly called patterns analysis on large sets of data, is the process of finding the patterns, associations or relationships among data using different analytical techniques involving the creation of a model and the concluded result will become useful information or knowledge (Ting et al., 2009). Lawal et al (2015) and Feelders et al (2000) noted that data mining is a process that allows users to extract patterns of knowledge from large data sets through the use of algorithms and techniques drawn from the field of Statistics, Machine Learning and Data Base Management Systems. It uses variety of

tools like query and reporting tools, analytical processing tools, and Decision Support System (DSS) tools.

DM techniques have been used to uncover hidden patterns and relations, to summarize the data in novel ways that are both understandable and useful to the executives, to predict future trends and behaviors in business (Goksen et al., 2011). Koh and Tan (2005) reported that data mining applications can greatly benefit all parties involved in the healthcare industry. For example, DM can help healthcare insurers detect fraud and abuse, healthcare organizations make customer relationship management decisions, physicians identify effective treatments and best practices, and patients receive better and more affordable healthcare services.

DM techniques can be classified based on the database, the knowledge to be discovered and the techniques to be utilized (El-Sappagh, 2013). Matkovsky and Nauta (1998), Ting et al. (2009) and El-Sappagh (2013) reported that the goal of DM is to learn from data and there are two broad categories of DM strategies: Supervised Learning (Predictive) and Unsupervised Learning (Descriptive). Table 1 shows the summary comparing the characteristics and the techniques used for the two different learning methods, while Table 2 outlines DM strategies by modelling objective, categorized by supervised and unsupervised distinctions.

In supervised learning, the goal is to predict the value of an outcome based on a number of input measures. It involves using some variables in data sets in order to predict unknown values of other relevant variables. The models and attributes are known and are applied to the data to predict and discover information (Obenshain, 2004; Ting, et al., 2009; Gorunescu, 2011; El-Sappagh, 2013). Classification, statistical regression and association rules building (dependency modelling) are very common supervised learning techniques used in medical and clinical research.

In unsupervised learning, there is no outcome measure, and the goal is to describe associations and patterns among a set of input measures. It involves finding human understandable patterns and trends in the data. The attributes and models are not known, but the patterns and clusters of data uncovered by DM can lead to new discoveries (Obenshain, 2004; Rupnik et al., 2007; Ting, et al., 2009; Gorunescu, 2011; El-Sappagh, 2013). Clustering and summarisation the common unsupervised techniques used in medical and clinical research (Gorunescu, 2011).

Prediction algorithms determine models or rules to predict continuous or discrete target values given input data; Classification algorithms determine models to predict discrete values given input data; Exploration uncovers dimensionality in input data; while Affinity analysis determines which events are likely to occur in conjunction with one another. Further details on these DM characteristics and the techniques used for the two different learning methods can be found in (Obenshain, 2004; Ting et al., 2009; Li et al., 2011; El-Sappagh, 2013; Guleria and Sood, 2014).

Table 1: Comparing the characteristics and the techniques of the unsupervised and supervised learning (Ting et al., 2009)

Characteristics		Techniques
Supervised Learning	With guidelines Class defined Common with vast literature and application	Classification Statistical Regression Artificial neural networks
Unsupervised Learning	No guidance Use to Define the class Seldom utilized (until recently)	Clustering Association Rule

Table 2: Modelling Objectives and Data Mining Techniques (Obenshain, 2004)

Modelling Objective	Supervised	Unsupervised
Prediction	Ordinary Least Squares Regression Logistic Regression Neural Networks Decision Trees Memory-based Reasoning Support Vector Machines Multi-Adaptive Regression Splines	Not feasible
Classification	Decision Trees Neural Networks Discriminant Analysis Bagging and Boosting Ensembles Naïve Bayes Classifiers	Clustering (e.g. K means) Kohonen Networks Self-Organizing Maps
Exploration	Decision Trees	Principal Components Clustering (e.g. K means) Link Analysis
Affinity		Associations Sequences Factor Analysis

During the past few years, researchers have tried to combine both unsupervised and supervised methods for the analysis (Hastie et al., 2001). Some examples of advanced supervised learning models are Classification And Regression Trees (CART) and Support Vector Machines (SVM) (Lee et al., 2005). Advanced examples of the unsupervised learning models are Hierarchical Clustering, C-means Clustering, Self-Organizing Maps (SOM) and Multidimensional Scaling Techniques. Liao et al (2012) reported that DM techniques developed recently includes generalization, characterization, classification, clustering, association, evolution, pattern matching, data visualization and meta-rule guided mining.

The most used software tools that provide these techniques (algorithms) are SPSS/SPSS Clementine, Salford Systems CART/MARS/TreeNet/RF, Yale (open source), SAS/SAS Enterprise Miner, Angoss Knowledge Studio/Knowledge Seeker, KXEN, Weka (open source), R (open source), Microsoft SQL Server, MATLAB and Oracle Data Miner (Shaker et al., 2013).

Krivda (1995) and Ting et al. (2009) noted that the typical DM process involves transferring data originally collected in production systems (such as electronic medical records) into data warehouse, cleaning or scrubbing the data to remove errors and check for format consistency, and then searching the data using statistical model, artificial intelligence (such as neural networks), and other machine learning methods.

2.2 Information Systems

Information Technology (IT) has become the cutting edge of global competition. Companies and organizations are keen to invest in information technology due to its potentials as a strategic enabling tool to support growth and enhance quality. IT is the area that manages technology which typically comprises of computer science, information systems, computer hardware, software, programming languages, network and many more. Conversely, Information Systems (IS) is a discipline that unites the business and computer science domain (Abdullah, 2013).

Silver et al. (1995) stated that “information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization”. Hence, the blend between people, organization and technology is the major concern in IS. Despite the differences between IT and IS, in most literature, these two terms are used interchangeably (Lee, 2004). In this paper, IS and IT are treated alike.

There is an abundance of IS domain literature merging between the business and technology realms. The business realm covers researchers in relation to business processes, business modeling, IT governance, IT management and others. The technology domain on the other hand, encompasses areas from IS development to IS deployment. IS research studies also varies according to applications such as decision support systems, knowledge management systems, database management systems, accounting information systems, manufacturing information systems, health information systems, transaction processing systems and many more. Other areas of IS studies include research

on methodology, analysis and design, and security (Abdullah, 2013). Figure 1 illustrates the diverse research areas in the IS domain.

Each IS research area has its own followers or research groups that sometimes intersect with other domains. This makes it difficult to streamline the areas of research in IS. The current study was devised to focus only on IS development, particularly for the health domain. In the next section, Health Information System concept is considered.

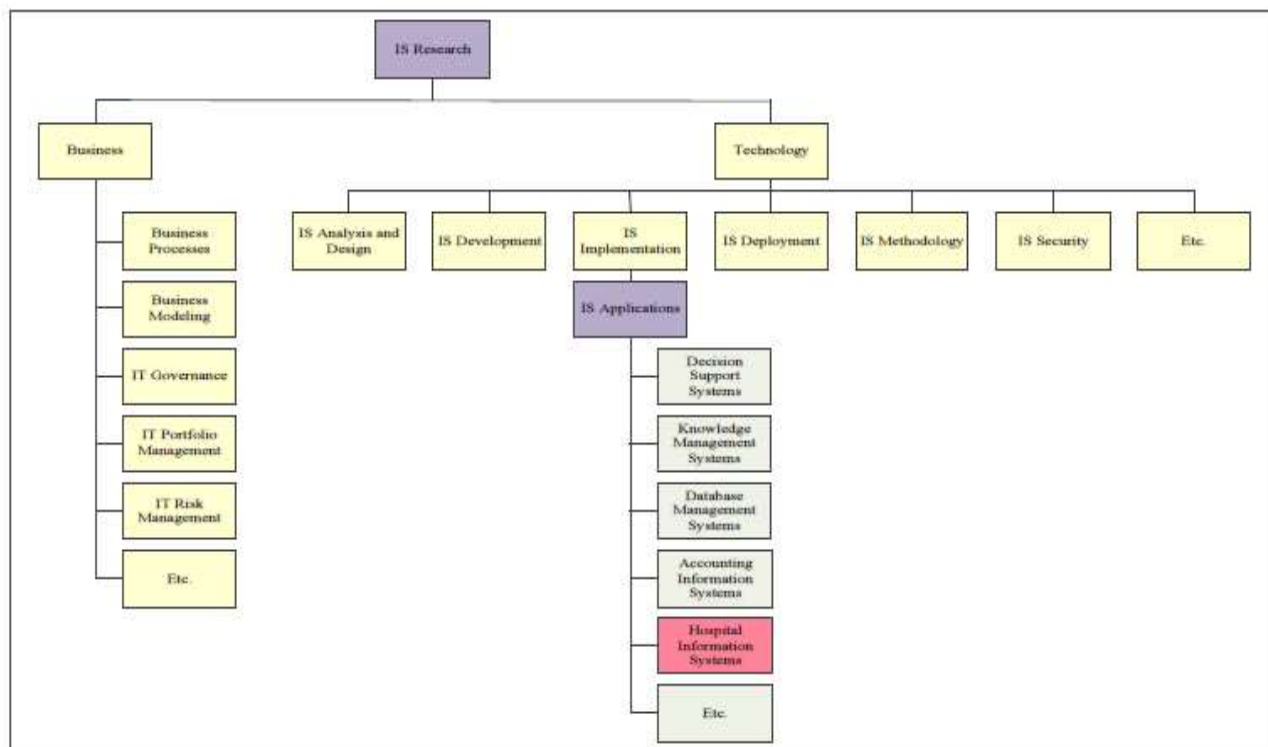


Figure 1: IS Research (Source: Adapted from Claver et al., 2000; Chiasson and Davidson, 2005; Walsham and Sahay, 2006; MIT Sloan, 2012; Abdullah, 2013)

2.3 Health Information System

The term Health Information Systems is the label given to information systems in the entire healthcare domain and the term Hospital Information Systems (HIS) focuses specifically on the information systems within hospitals, the scope and definition of Hospital Information Systems (HIS) is seen as a subset of Health Information Systems. In the current study the term Hospital Information Systems (HIS) is preferred, though some researchers use the terms interchangeably (Kuhn and Giuse, 2001).

There are alternative definitions of HIS. For example, Aggelidis and Chatzoglou (2008) defined HIS as a computer-based system designed to facilitate the management of the administrative and medical information within a hospital. Biohealthmatics.com (2006) defined HIS as a computer system that is designed to manage all the hospital's medical and administrative information in order to enable health professional perform their jobs effectively and efficiently. While Haux (2004) defined HIS as the socio-technical

subsystem of a hospital, which comprises all information processing as well as the associated human or technical actors in their respective information processing roles.

Typically, as depicted in Figure 2, HIS have subsystems such as Clinical Information System (CIS), Financial Information System (FIS), Laboratory Information System (LIS), Pharmacy Information System (PIS), Radiology Information System (RIS), Picture Archiving Management System (PACS) and the Nursing Information System (NIS) (Biohealthmatics.com 2006). Figure 2 illustrates typical view of how the HIS subsystems connect. The number of subsystems to be installed is decided by the hospital management; implemented separately by an incremental approach or simultaneously by means of a big bang approach.

The 'big bang' installs the entire system at once whereas an incremental approach allows users to implement a few subsystems at a time. An incremental approach is greatly recommended because it allows the users to become accustomed to the new system gradually. Many authors caution about the danger of the 'big bang' approach since it does not permit users to adapt progressively to change (Anderson and Stafford, 2002; Jones, 2003; Ludwick and Doucette, 2009). The descriptions for HIS subsystems and analogous health systems are described in Abdullah (2013).

Among the benefits of an HIS system are that it includes automate tasks, fast retrieval of records, simplifies projections tasks, improves productivity, speedily assesses bed vacancies, hastens lab test results, shortens waiting time, schedules appointments, avoids misplaced records, reduces errors and provides a repository of valuable information (Bulgiba, 2004). Bulgiba (2004) added that the benefits of HIS aid in achieving enhanced patient safety aspects because life-saving decisions may be performed faster and inaccurate drug prescriptions may be minimized. Further, Goldschmidt (2005) supported the view that HIS lessens administrative expenses, improves the quality of patient care, automates sharing of health information and reduces the risk of negligence

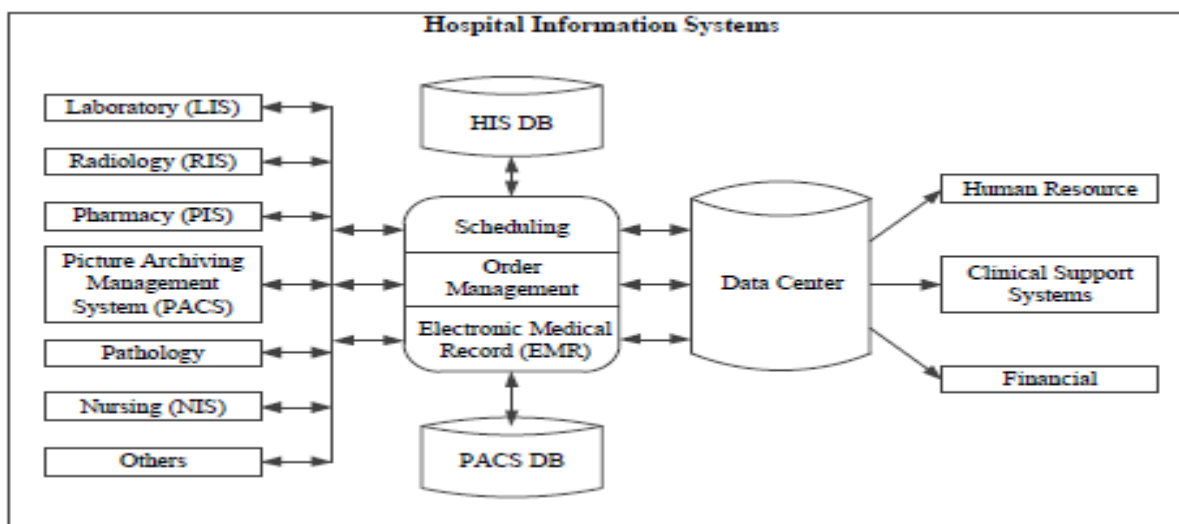


Figure 2: HIS and its Subsystems (Source: Adapted from Wainwright and Waring, 2000; Abdullah, 2013).

2.4 Related Works

Numerous researches have been carried on Clinical Decision Support System (CDSS). Surveys of such work can be found in Shahsavarani et al (2015). Some works also reported the use of DM techniques to find new patterns and knowledge from biomedical data. Such includes the following:

Megalooikonomou et al. (2000) introduced statistical methods that aid the discovery of interesting associations and patterns between brain images and other clinical data. Brossette et al. (2000) designed a Data Mining Surveillance System (DMSS) that uses novel DM techniques to discover unsuspected, useful patterns of nosocomial infections and antimicrobial resistance from the analysis of hospital laboratory data.

Antonie et al. (2001) investigated the use of different DM techniques for anomaly detection and classification of medical images. Delen et al. (2005) used two popular DM algorithms (Artificial Neural Networks and Decision Trees) along with a most commonly used statistical method (Logistic Regression) to develop the prediction models on breast cancer using a large dataset.

Su et al. (2006) used four different DM approaches to select the relevant features from the data to predict diabetes. Phillips-Wren et al. (2008) assessed the utilization of healthcare resources by lung cancer patients related to their demographic characteristics, socioeconomic markers, ethnic backgrounds, medical histories, and access to healthcare resources in order to guide medical decision making and public policy.

Some works also discussed the use of DM in business processes in general and they also represent important basis for our research. Khademolqorani and Hamadani (2013) presents the recent study in this area. Chung and Gray (1999) argued that there is a lot of research done in the areas of DM model creation, but there is a lack of research done in the area of the use of DM models in operational business processes. Kohavi and Provost (2001) argued that it is important to enable the use of DM in business processes through automated solutions. They discussed the importance of the ease of integration of DM in business processes. In their paper, they discussed the integration of DM in business processes as the consequence of the need to incorporate background knowledge in business processes. They stated that deploying automated solutions to previously manual processes can be a rife with pitfalls. Authors also argued that one must deal with social issues when deploying automated solutions to previously manual processes.

Feelders et al. (2000) discussed the use of DM in business processes with the emphasis on the integration of DM models and solutions into existing application systems within IS. Authors argued that it is essential that the results of DM are used to support operational business processes like direct mailing for the selection of potential customers. Gray (2005) discussed DM as an option of knowledge sharing within the enterprise. Through the integration of DM in operational business processes, knowledge sharing is not only present in business processes on a tactical level, but also on operational level.

Rupnik et al. (2007) developed a DM process model and appropriate DM based decision support system to support decision processes in the telecommunication company. They explored the use of DM application systems approach. In this approach, the DM was not used in ad-hoc projects, but through DM based decision support systems. The aim of the work was to define how business users can use DM models to facilitate decision making where DM experts create DM models and business users use them.

A review of the above related works with literature analysis revealed that little or no work has been done in the area of the use of DM techniques in operational business processes, such as in Hospital Information System (HIS). Therefore, this work developed a HIS that incorporated DM model called SHIMS in order to assist the strategic management mechanisms in hospital operational business processes.

3. Methodology

In this work, the System Development Life Cycle (SDLC) methodology or framework was adapted. From the engineering, information processing and information system development literature, the formal design of any information processing system is supposed to follow a set of steps labeled the System Development Life Cycle (SDLC). However, as Sprague and Carlson (1982) and other authors (Davis, 1983; Aktas, 1987) have noted, the traditional SDLC is somewhat difficult to use as originally specified. But there is agreement that the SDLC has four general or essential phases: (i) system analysis, (ii) system design, (iii) system construction or development and (iv) system implementation.

3.1 System Analysis

Analysis involved a detailed study of the current system and it includes sub dividing of complex process involving the entire system, identification of data store and manual process. During analysis, data are collected on available files, decision points and transactions handled by the present system. Interviews, case study, document and archives, on-site observations, questionnaire and review of literature are the tools used to establish the objectives, requirements and services expected from the system.

3.2 System Design

System design brings a proposed system much closer by describing the nature of input and output file as well as sharing the processing in which they are connected. These design elements consisted of functional hierarchy, business process diagrams, pseudo code and entity-relationship diagram. In this stage the design elements are defined with the help of interviews, case study, document and archives, on-site observations, questionnaire and review of literature conducted. These design elements provided detail description about the software and each element is related to a specific requirement

3.3 System Development

The development stage was initialized by the previous design stage. At this stage the code for the design elements of system was written using Hypertext Protocol (PHP) as the programming language and Microsoft SQL Server 2008 as the database server, and it provided the functional system components. PHP was chosen because it is an open source server-side scripting language designed for web development (but can also be used as a general-purpose programming language), and can interact with Microsoft SQL databases. Also, Microsoft SQL Server 2008 was chosen because it is a relational database management system (RDBMS) that supports a wide variety of transaction processing, business intelligence and analytics applications in corporate IT environments. It enables the creation, maintenance and management of database. Microsoft SQL Server 2008 is a Structured Query Language (SQL) based, client/server relational database.

3.4 System Implementation

To implement a web application, client-server architecture is required. The most popular client-server architectures are the two-tier and the three-tier architecture. The choice of architecture affects the development time and the future flexibility and maintenance of the application. While selecting the architecture most suitable for an application, many factors including the complexity of the application, the number of users and their geographical dispersion are considered.

This system was designed based on a traditional three-tier architecture used by many web applications. Three-tier architecture includes a presentation layer, business rules/logic layer, and the data layer. The Data layer is responsible for data storage. Primarily this tier (layer) consists of one or more relational databases and/or file systems. The Business Rules/Logic layer is the middleman between the presentation layer and the data layer. This middle tier was introduced to overcome the deployment limitation (whenever the application logic changed the application had to be redistributed at each and every client) in the two-tier architecture. The middle tier provides process management where business logic and rules are executed and can accommodate hundreds of users.

The Presentation Layer, also called the Client tier, is responsible for the presentation of data, receiving user events, and controlling the user interface. The user interaction with the system is entirely through this layer. The three-tier architecture is generally used when an effective distributed client/server design is needed that provides: increased performance, flexibility, maintainability, reusability and scalability. This model hides the complexity of distributed processing from the user. These features have made the three-tier architecture a popular choice over the two-tier architecture for Internet applications.

In addition, a web server is required to implement any web-based application. A web server is a piece of software that manages web pages and makes them available to the 'client' browser – via a local network or over the Internet. The web server can be accessed remotely or locally. There are many web servers available such as Apache,

Microsoft Internet Information Services (IIS), Netscape Web Server and many more. However, in this work Apache was chosen as web server (WAMP Server 1.7.0 running Apache Web Server version 2.2.4) because of its availability as open source software and compatibility with PHP, Microsoft SQL Server 2008.

4. Result and Discussion

The web-based Strategic Management Hospital Information System was developed using Hypertext Protocol as the programming language and Microsoft SQL Server 2008 as the database server and implemented using three-tier architecture as described in section 3 above. The system was tested using three testing techniques (White box, Usability and Black box) to check the validity, correctness, completeness and to evaluate the quality of the system.

The application provides features such as the passcode database, staff/employee database, patient database, patients' treatment database, extract patient information database, staff/employee information report, patients details report, patients' treatment report and extraction information report based on pattern. To gain access to the system every user should be authenticated. When the user types the website's URL in the browser, the login page is displayed as shown in Figure 3.

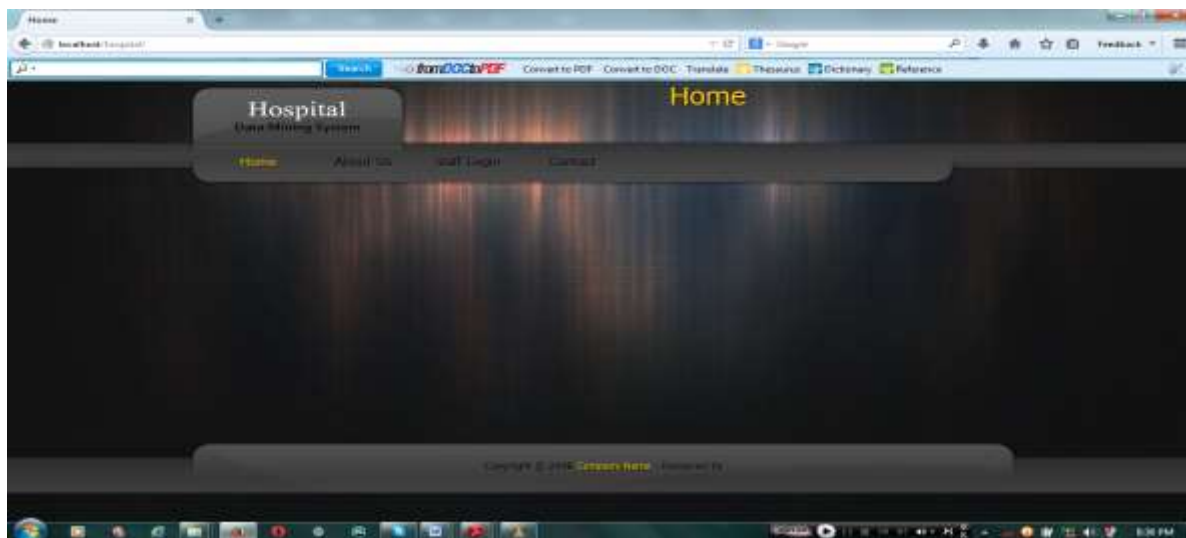


Figure 3: Home Page

Depending on the role selected in the login page the user is directed to the respective subsystem, the user (staff) subsystem, or the Administrator subsystem. Some of the other graphical user interface of the developed system is depicted in Figures 4 to 10.

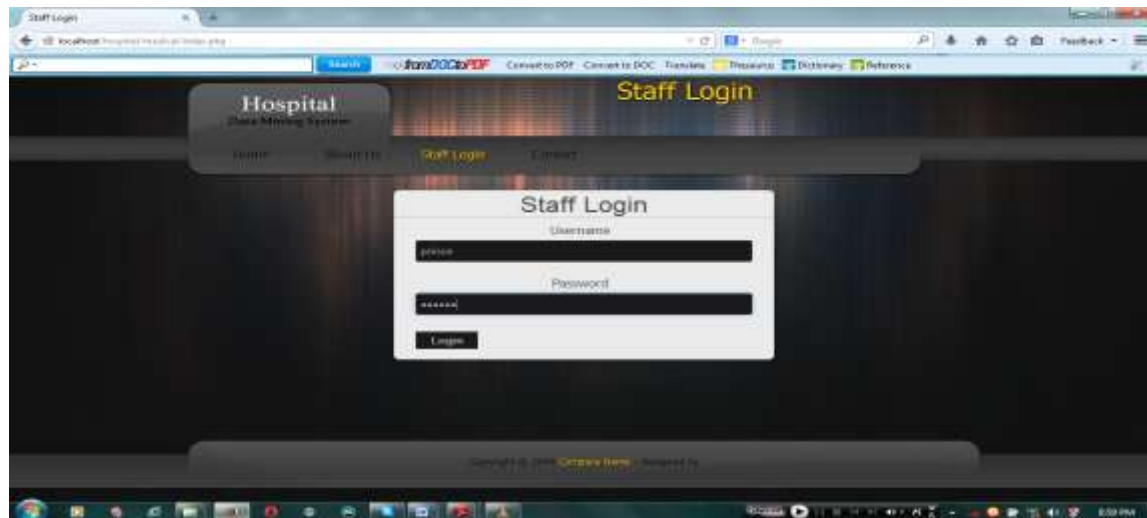


Figure 4: Login Page



Figure 5: Registered Patient Details

The screenshot shows a web browser window with the URL 'localhost:192.168.1.100/hospital_data_mining_system'. The page has a dark header with 'Hospital Data Mining System' on the left and 'User prince' on the right. Below the header is a 'New Patients Information' form with the following fields:

- Surname: [Text Input]
- Other names: [Text Input]
- Gender: [Dropdown Menu (MALE selected)]
- DOB: [Day (01), Month (JAN), Year (1980)]
- Phone Number: [Text Input]
- Address: [Text Input]

Figure 6: Patient's Biodata Registering

The screenshot shows the 'SEARCH RESULT' page with a search bar and an 'Advanced Search' section. Below these is a table with patient data. The table has 12 columns: ID, SURNAME, OTHER NAMES, SEX, DOCTOR, DIAGNOSIS, PRESCRIPTION, STATUS, DATE ADMITTED, DATE DISCHARGED, No(s) of Days, and ACTION.

ID	SURNAME	OTHER NAMES	SEX	DOCTOR	DIAGNOSIS	PRESCRIPTION	STATUS	DATE ADMITTED	DATE DISCHARGED	No(s) of Days	ACTION
PAT-141030210	LUANA	ANNA	Female	Dr. KARA	Diabetes	Drugs	Discharged	1/1/2000	3/1/2000	60	VIEW RECORD
PAT-141030223	ANNA	ANNA	Male	Dr. KARA	Diabetes	Drugs	Discharged	1/1/2000	3/1/2000	60	VIEW RECORD

Figure 7: Advance Search

The screenshot shows the 'Patient's Record' page for Patient ID (PAT-141030305). The page displays the following information:

- Patient's Record Patient ID (PAT-141030305)**
- NAME:** OLUFEMI ABELUJAYE
- SEX:** MALE
- Date of Birth:** 1/1/1972
- Phone Number:** 08170341078
- Address:** 45th Street, Lagos
- EMail:** ABELUJAYE@GMAIL.COM
- STATUS:** Discharged
- DOCTOR INCHARGE:** DR. KARA (STP-141030473)
- DATE OF ADMISSION:** 1/1/2000
- DATE OF DISCHARGE:** 3/1/2000
- DIAGNOSIS:** Diabetes
- DOCTOR'S REPORT:** Patient needs further care
- PRESCRIPTION:** Drugs

Figure 8: View Registered Patients' Information



Figure 9: Add New Staff



Figure 10: Create New Department

The analytical decision-making ability of the developed web-based Strategic Management Hospital Information System was tested based on three selected patterns (parameters): Doctors, Ailments and Year. Doctor is a parameter that was used to mining the doctor performance based on the attendance to the patients and the doctor ability on the patients in relate to ailments and years. Doctor parameter can be used to determine the rate of each status (Death, Discharged, Transferred and On-admission) of which each Doctor have on their patient each year.

Ailments was a parameter that was used to determine the most occurrences ailments in each year and to determine the rate of each status (Death, Discharged, Transferred and On-admission) and the Doctor performances at each ailment in each year. Year was a parameter that was used determine the rate of status (Death, Discharged, Transferred and On-admission) of each ailment in each year provided or choose between

the years used in the application. Year was also used to determine and show the performance of each Doctor according to the year selected.

Figures 11, 12 and 13 depict the performances of the four Doctor used in this application. The performances of these Doctors are showing for each year, from 2017 to 2019 and the parameter used are: (i) Ailment Diagnosis (Malaria, Cholesterol, Arthritis, High Blood Pressure, Fever Bladder Infection, Ashma, Cancer, Chicken Pot, Diabetes, Heart Disease, HIV / AIDS, STD, Injury / Accident) and (ii) Treatment Status (Discharged, Transferred, Death, On Admission)

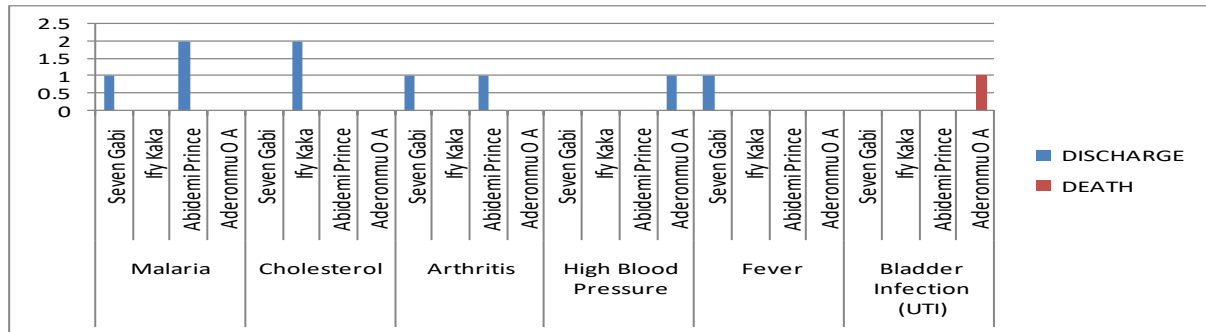


Figure 11: 2017 Doctor, Diagnosis and Status

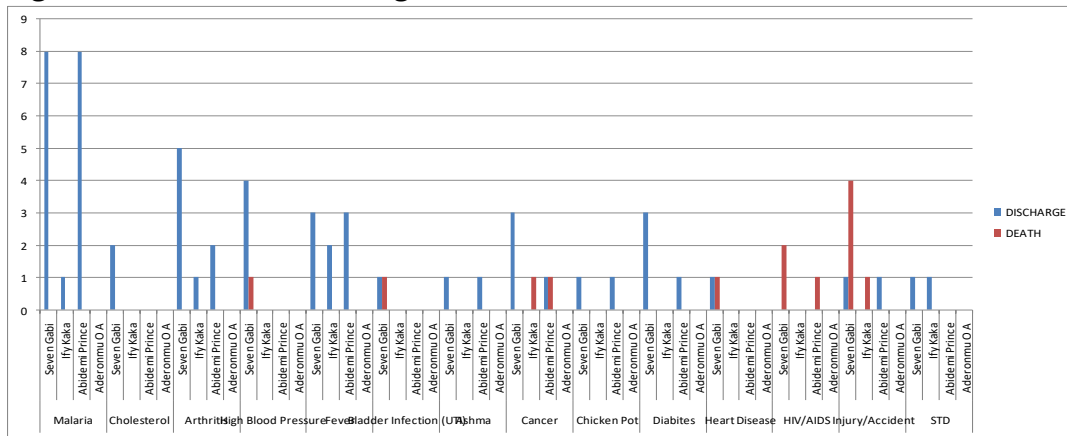


Figure 12: 2018 Doctor, Diagnosis and Status

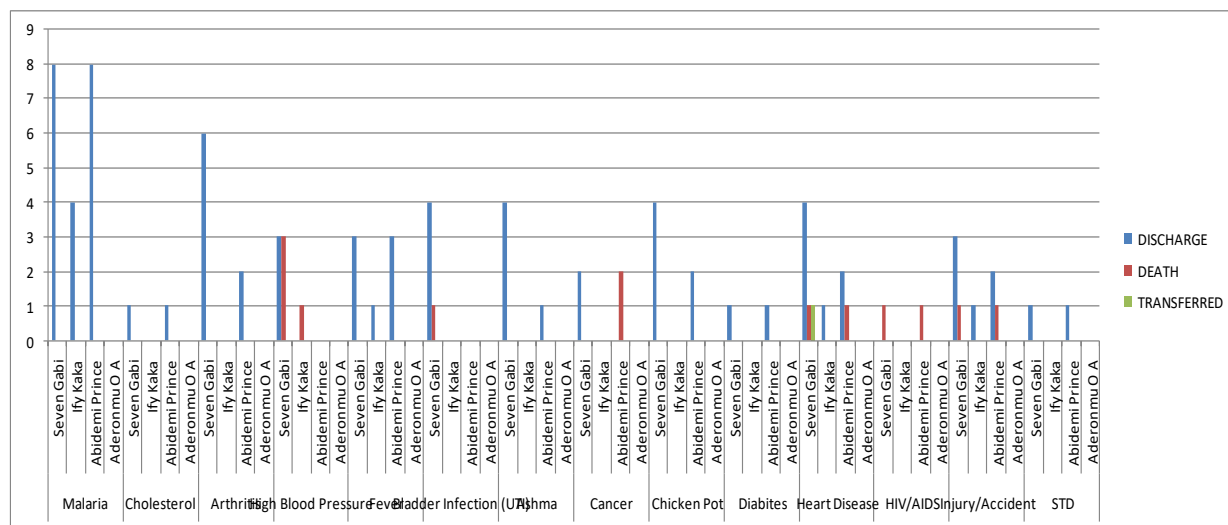


Figure 13: 2019 Doctor, Diagnosis and Status

In 2017, Figure 11 illustrates that Doctor Abidemi Prince have the high rate of Discharge Malaria Patients, Doctor Ify Kaka have high rate of Discharge Cholesterol Patients and Doctor Aderonmu O. A have Death Patient of Bladder Infection, while in 2018, Figure 12 depicts that Doctor Abidemi Prince and Doctor Steve Gabi have the high rate of Discharge Malaria and Fever Patients, Doctor Steve Gabi have high rate of Discharge Cholesterol, Arthritis, High Blood Pressure, Cancer, Diabetes Patients and have high rate of Death patients in HIV/AIDS and Injury/Accident.

In 2019, Figure 13 shows that Doctor Abidemi Prince and Doctor Steve Gabi have the high rate of Discharge Malaria and Fever Patients, Doctor Steve Gabi have high rate of Discharge Asthma, Arthritis, High Blood Pressure, Bladder Infection, Chicken Pox and Heart Disease Patients and have high rate of Death patients in High Blood Pressure and Doctor Abidemi Prince have high rate of Death Patients in Cancer. This shows that the developed web-based HIS (SHIMS) is enriched with analytical solutions to support in strategic planning and decision-making and thereby assisted the strategic management mechanisms of the HIS.

5. Conclusion and Recommendations

This paper presents the development of web-based Strategic Hospital Information Management System (SHIMS). The use of DM technology to support the data processing, information retrieval and knowledge generation process in order to support decision making in HIS offer obvious advantages over traditional HIS called legacy systems. When analytical technologies are embedded in Modern HIS that gather and centrally store large amounts of data, this will assist the strategic management mechanisms and improvements in clinical decision-making. The developed SHIMS offered capabilities to increase the productivity of medical personnel, analyze care outcomes, lower healthcare costs, improve healthcare quality by using fast and better clinical decision making and generally support the analytical decision-

making process.

Further exploration of data mining for research related to health information systems seems in order, especially where the data volume exceeds capabilities of traditional statistical techniques. Models produced via data mining and predictive analysis can form the backbone of future health information systems.

6. References

- Abdullah, Z. A. (2013). Hospital Information Systems Implementation Framework: Critical Success Factors for Malaysian Public Hospitals. Unpublished Ph.D Thesis, Curtin University
- Abraham, C., Nishihara, E. and Akiyama. M. (2011). Transforming Healthcare with Information Technology in Japan: A Review of Policy, People, and Progress. *International Journal of Medical Informatics*, 80 (3): 157-170.
- Aggarwal, N., Kumar, A., Khatter, H. and Aggarwal, V. (2012). Analysis the effect of data mining techniques on database. *Advances in Engineering Software*, 47(1): 164-169.
- Aggelidis, V.P. and Chatzoglou, P. D. (2008). Methods for Evaluating Hospital Information Systems: A Literature Review. *EuroMed Journal of Business*, 3 (1): 99-118.
- Aktas, A. Z. (1987). Structured analysis and design of information systems. Englewood Cliffs, NJ:Prentice Hall.
- AlZoubi, W. A. (2013). Mining Medical Databases Using Graph based Association Rules. *International Journal of Machine Learning and Computing*, 3(3): 294-296.
- Anderson, L.K. and Stafford, C. J. (2002). The "Big Bang" Implementation: Not for the Faint of Heart. *Computers in Nursing*, 20 (1): 14-20.
- Armoni, A. (2002). Effective Healthcare information systems, IRM Press.
- Bawden, D. (2005). Data Mining and Decision Support: Integration and Collaboration. *Journal of Documentation*, 61(3): 443-445.
- Biohealthmatics.com. (2006). Hospital Information Systems. Accessed 24 Dec 2020, <http://www.biohealthmatics.com>.
- Bulgiba, A.M. (2004). Information Technology in Health Care – What the Future Holds. *Asia Pacific Journal of Public Health*, 16 (1): 64-71.
- Buntin, M.B., Burke, M. F., Hoaglin, M. C. and Blumenthal, D. (2011). The Benefits of Health Information Technology: A Review of the Recent Literature Shows Predominantly Positive Results. *Health Affairs*, 30 (3): 464-471.
- Chiasson, M.W. and Davidson, E. (2005). Taking Industry Seriously in Information Systems Research. *MIS Quarterly*, 29 (4): 591-605.
- Claver, E., González, R. and Llopis, J. (2000). An Analysis of Research in Information Systems (1981-1997). *Information & Management*, 37 (4): 181-195.
- Davis, W. S. (1983). Systems analysis and design: A structured approach. Reading, MA: Addison Wesley.
- Dutta, A, and Heda, S (2000). Information systems architecture to support managed care business process. *Decision Support Systems*, 30: 217-225.
- El-Sappagh, S. H., El-Masri, S., Riad, A. M., and Elmogy, M. (2013). Data Mining and Knowledge Discovery: Applications, Techniques, Challenges and Process Models in Healthcare. *International Journal of Engineering Research and Applications*, 3(3): 900-906.

- Feelders, A., Daniels, H. and Holsheimer, M. (2000). Methodological and Practical Aspects of Data Mining. *Information and Management*, 271-281.
- Goksen, Y., Eminagaoglu, M. and Dogan, O. (2011). Data Mining in Medical Records for the Enhancement of Strategic Decisions: A Case Study. *Scientific Bulletin – Economic Sciences*, 10(1): 135-144.
- Goldschmidt, P.G. (2005). HIT and MIS: Implications of Health Information Technology and Medical Information Systems. *Communications of the ACM*, 48 (10): 68-74.
- Gorunescu, F. (2011). Data Mining: Concepts, Models, and Techniques. India: Springer.
- Guleria, P. and Sood, M. (2014). Data Mining in Education: A Review on the Knowledge Discovery Perspective. *International Journal of Data Mining & Knowledge Management Process*, 4(5): 47- 60.
- Hampshire, D. A. and Rosborough, B. J. (1993). The evolution of decision support in a managed care organization. *Topics in Healthcare Financing*, 20(2):26-37.
- Hastie, T., Tibshirani, R. and Friedman, J. (2009). The elements of statistical learning: Data mining, inference, and prediction. Second Edition. Springer, New York, USA.
- Haux, R. (2004). Strategic Information Management in Hospitals: An Introduction to Hospital Information Systems. New York, NY, USA: Springer Verlag.
- Haux, R. (2006). Health Information Systems - Past, Present, Future. *International Journal of Medical Informatics*, 75 (3-4): 268-281.
- Health Information and Management Systems Society (2008). Enabling Healthcare Reform using Information Technology. <http://www.himss.org>.
- Jones, M.R. (2003). Computers Can Land People on Mars, Why Can't They Get Them to Work in a Hospital. *Methods Inf Med*, 42: 410-415.
- Khademolqorani, S. and Hamadani, A. Z. (2013). An Adjusted Decision Support System through Data Mining and Multiple Criteria Decision Making. *Procedia - Social and Behavioral Sciences*, 3: 388-395
- Koh, H. C. and Tan, G. (2005): Data Mining Applications in Healthcare. *Journal of Healthcare Information Management*, 9(2): 64-72.
- Krivda, C. D. (1995). Data-Mining Dynamine. Byte.
- Kuhn, K.A. and Giuse. D. A. (2001). From Hospital Information Systems to Health Information Systems. *Methods of Information in Medicine*, 40 (4): 275-287.
- Lavrac, N., Mladenic, D., Bohanec, M. and Moyle, S. (2003). Data Mining and Decision Support: Integration and Collaboration. Springer.
- Lawal, N. T. A, Odeniyi, O. A. and Kayode, A. A. (2015): Application of Data Mining and Knowledge Management for Business improvement: An Exploratory Study. *International Journal of Applied Information Systems*, 8(3):13-19.
- Lee, A.S. (2004). Thinking About Social Theory and Philosophy for Information Systems. *Social Theory and Philosophy for Information Systems*: 1-26.
- Lee, J. W., Lee, J. B., Park, M. and Song, S. H. (2005). An extensive comparison of recent classification tools applied to microarray data. *Computational Statistics & Data Analysis*, 48(4): 869-885.
- Liao, S-H., Chu, P-H. and Hsiao, P-Y. (2012). Data mining techniques and applications – A decade review from 2000 to 2011. *Expert Systems with Applications*, 39:11303-11311
- Li, J., Wei, L., Li, G. and Xu, W. (2011) An evolution strategy-based multiple kernels multi

- criteria programming approach: The case of credit decision making, *Decision Support System*, 51: 292-298.
- Ludwick, D.A. and Doucette, J. (2009). Adopting Electronic Medical Records in Primary Care: Lessons Learned from Health Information Systems Implementation Experience in Seven Countries. *International Journal of Medical Informatics*, 78(1): 22-31.
- MacIennan, J., Tang, Z. and Crivat, B. (2008). Data mining with Microsoft SQL server 2008, Indianapolis, Wiley.
- Matkovsky, I. P. and Nauta, K. R. (1998). Overview of data mining techniques. Presented at the Federal Database Colloquium and Exposition; September 9-11; San Diego, CA.
- MIT Sloan. (2012). Center for Information Systems Research - MIT Sloan School of Management. Accessed September 05, 2020, <http://cistr.mit.edu>.
- Novak, J. and Judah, A. (2011). Towards a Health Productivity Reform Agenda for Australia. <http://www.achr.com.au>.
- Obenshain, M. K. (2004). Application of Data Mining Techniques to Healthcare Data. In: Statistics for Hospital Epidemiology, Birnbaum, D. (ed.), 25(8): 690-695.
- Prins, S and Stegwee, R. A. (2000). 'Zorgproducten en geïntegreerde informatiesystemen', (in Dutch) *Handboek sturen met zorgproducten*, F3100-3, december.
- Rada, R. (2002). Information systems for Healthcare enterprises. Hypermedia Solutions Limited.
- Rupnik, R., Kukar, M. and Krisper, M., (2007) Integrating data mining and decision support through data mining based decision support system. *Journal of Computer Information Systems*, 47(3):89-104.
- Rupnik, R. and Jaklic, J. (2009). The Deployment of Data Mining into Operational Business Processes, In Data Mining and Knowledge Discovery in Real Life Applications, Julio Ponce and Adem Karahoca (Ed.), InTech, pp. 373-388.
- Sakthimurugan, T. and Poonkuzhali, S. (2012). An Effective Retrieval of Medical Records using Data Mining Techniques. *International Journal of Pharmaceutical Science and Health Care*, 2 (2): 72-77.
- Seng, J.-L. and Chen, T. C. (2010). An analytic approach to select data mining for business decision. *Expert Systems with Applications*, 37, 8042-8057.
- Shaker, H., El-Sappagh, S., El-Masri, A. M. and Riad, M. E. (2013). Data Mining and Knowledge Discovery: Applications, Techniques, Challenges and Process Models in Healthcare. *International Journal of Engineering Research and Applications*, 3(3): 900-906.
- Sheng, O. R. Liu (2000). Decision support for healthcare in a new information age. *Decision Support Systems*, 30:101-103.
- Silver, M.S., Markus, M. L. and Beath, C. M. (1995). The Information Technology Interaction Model: A Foundation for the MBA Core Course. *MIS Quarterly*, 19 (3): 361-390.
- Sprague, R. H. and Carlson, E. D. (1982). Building effective decision support systems. Englewood Cliffs, NJ: Prentice Hall.
- Ting, S. L., Shum, C. C., Kwok, S. K., Tsang, A. H. C. and Lee, W. B. (2009). Data Mining in Biomedicine: Current Applications and Further Directions for Research. *Journal of Software Engineering & Applications*, 2, 150-159

- Wainwright, D. and Waring, T. 2000. The Information Management and Technology Strategy of the UK National Health Service – Determining Progress in the NHS Acute Hospital Sector. *International Journal of Public Sector Management*, 13 (3):241-259.
- Walsham, G. and Sahay, S. (2006). Research on Information Systems in Developing Countries: Current Landscape and Future Prospects. *Information Technology for Development*, 12 (1): 7-24.
- Wang, D. Y. (2010). Advanced Studying on Microsoft SQL Server 2008 Data Mining. *Applied Mechanics and Materials*, 20 - 23, 748 - 752.
- Zuckerman and Alan, M. (2006). 'Healthcare Strategic Planning', Prentice Hall of India

DESIGN AND IMPLEMENTATION OF AN ELECTRONIC MOSQUITO REPELLENT

Yusuf, Abdulkawiyu K.^{1*}

Sanusi, Mufutau. A.²

¹Department of Electrical and Electronics Engineering, Villanova Polytechnic, Imesi-ile, Imesi-ile, Osun State, Nigeria.

²Department of Electrical and Electronics Engineering, Federal Polytechnic, Ede, Ede, Osun State, Nigeria.

e-mail: engryusufak@gmail.com

Abstract

The control of mosquitoes is an issue of utmost importance in the present day as a result of rising number of mosquito borne illnesses which have resulted in the use of various types of pesticides, herbicides and other mosquito's repellent agents that are toxic and a risk to human health. This risk has necessitated the design of an Electronic Mosquito Repellent, EMR as a means of controlling the menace of mosquitoes that is very effective, cheap, eco-friendly and produces no risk to human health. Electronic Mosquito Repellent is an electronic device that has the capability of generating high frequency sound waves of high pitch at an Ultrasonic frequency range, not audible to human ear but to insects and pests. The constructed EMR generates ultrasonic sound waves at a frequency range of 20 – 38 kHz that travels at an angle 45° from the source to cover a wide radius. Due to the intense auditory stress of these ultrasonic sound waves on the mosquitoes, they are rendered inactive or forced away from the vicinity of the device. The device is designed on 555 Timer IC and can be used indoors or outdoors by the general public to combat the menace of mosquitoes.

Keywords – 555 Timer, A stable multivibrator, Buzzer, Electronic mosquito repellent, Ultrasonic frequency, Ultrasonic sound

1.0 Introduction

Malaria affects more than 250 million people and causes more than a million deaths annually [22]. One important preventive strategy against this and other mosquito-borne diseases is control, which aims to reduce human-mosquito contact. Different control measures are used routinely against mosquitoes and their larvae, including chemical (e.g. insecticides), biological (e.g. carnivorous fish, carnivorous flowers or pathogenic fungi), environmental (e.g. land filling or draining of drainage), and personal protection (e.g. mosquito repellents formulated as pills, coils, ointments, lotions, sprays and insecticide treated and untreated bed nets). Electronic mosquito repellents (EMRs) are marketed in response to a huge demand from the public for convenient, safe, and effective anti-mosquito products [18].

Malaria is a major health problem that particularly affects people living in Sub-Saharan Africa and other tropical parts of the world. It often causes considerable morbidity and mortality especially in children under five. It is transmitted by mosquito bites from infected female mosquitoes. Severally strategies and approaches are available for preventing mosquito bites and malaria infection, including repellents and these approaches will be considered by those living in affected areas and by travelers to areas where there is high risks of infection. There was no evidence in the field studies to support their promotion or use. Future randomized controlled trails are not proposed as there was no suggestion in the field of studies that EMRs show any promise as a preventive measure against malaria [12].

An electronic insect repellent is a safer alternative compared to toxic insect repellent. These are electronic

devices that have either electromagnetic or ultra sound waves to repel mosquitoes and roaches. The effectiveness of these devices has not been clearly established but the numerous studies foe experiments have shown that these electrical devices are indeed effective in repelling or eliminating pests. Some examples of electronic insects repellents are plug in electronic repellents, ultrasonic transmitters and the electromagnetic lamps. These electronic pest control devices are very affordable [10], [16].

Human, animal or anything can produce sound. This sound is created by the insect during their movement or anything. Insect can be defined as any of numerous small invertebrate (without a backbone) animals (as centipedes or spiders) that are more or less obviously segmented. Insects can be a nuisance to human and, under certain conditions, can be a hazard to health and lives of people. There are many approaches to controlling insects' populations, including chemical pesticide control, insect-repelling plants and insect's traps. Electronic pest control devices also provide a convenient means for controlling insects in or near your home [4].

However, research has shown that male mosquitoes are actually the ones attracted by the female flight sound and females normally have a very weak sensitivity for sound compared with the males. Another reason is that mosquitoes avoid the ultrasonic cries of bats, although both explanations may be conceivable, there is no published scientific information to support either idea. Different brands of EMRs have been examined for their efficacy under laboratory conditions, none of which showed any effects for the devices tested [1], [3].

2.0 Review of Related Work

"The world's most dangerous animal is the mosquito," according to a BBC World Service health program as they carry of many harmful diseases like Malaria, Dengue Fever,

Chikungunya, Lyme disease etc. Chemical repellent is used generally to repel mosquito which has a remarkable safety profile, but they are toxic against the skin & nervous system and also causes rashes, swelling, and eye irritation. It causes brain swelling in children, anaphylactic shock, and low blood pressure [8]. Also, it has discovered that Chemicals brings about the genetic mutation of the internal make up of these pests such as mosquitoes that they produce off spring that are immune to these chemicals that were used on their earlier generation [10]. There have been several focused on designing an ultrasonic pest repellent system which can be a very useful device to counter the various problems due to ants, insects, pests, rodents, etc. Due to the compactness, low cost and pollution free source unlike the other chemical repellents the device can be highly effective [16].

The electronic ultrasonic repellent device of [13] was designed to repel many types of insects other than mosquitoes. On activation of the device, it was discovered that some of the insect moved away at certain constant frequency but other species of insect didn't move as repelling frequency was found different for different species of arthropods. Author [4] also talks about a circuit of an electronic pest repellent. It is effective over a diameter around 16 meters. Wide varieties of electric mosquito repellent that are still not in practice so much are available in market. These basically consist of a small hot plate or a chemical mat in order to produce smokes and fumes. These fumes not only affect the mosquitoes and other insects but also adversely to human beings. Some of these devices are costly in operation as well. This Electronic Mosquito Repellent only uses generated ultrasonic waves rather than chemical fumes or harmful toxic smoke. This circuit generates ultrasonic wave as an output in the range of 20 - 38 kHz that travels at an angle 45° from the source to cover a wide radius. Ultrasonic wave is not audible to us and hence is harmless to human beings. The oscillator unit is built using 555 timer astable multivibrator which is responsible for driving a piezo buzzer that converts the ultrasonic frequency to sound wave at high pitch as the desired output. This EMR has power efficiency of 9-volts DC and it is portable, cheap and designed based on simple and elegant circuit.

3.0 Methodology

3.1 Block Diagram

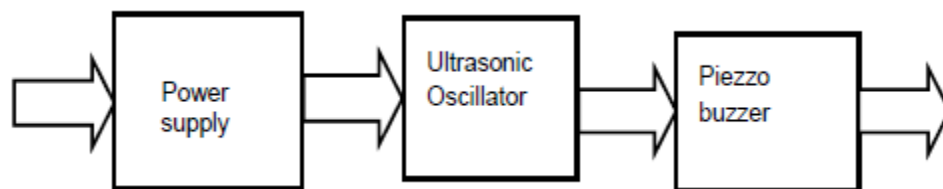


Figure 1: The block diagram of an Electronic Mosquito Repellent

3.2 Design of Electronic Mosquito Repellent Circuit

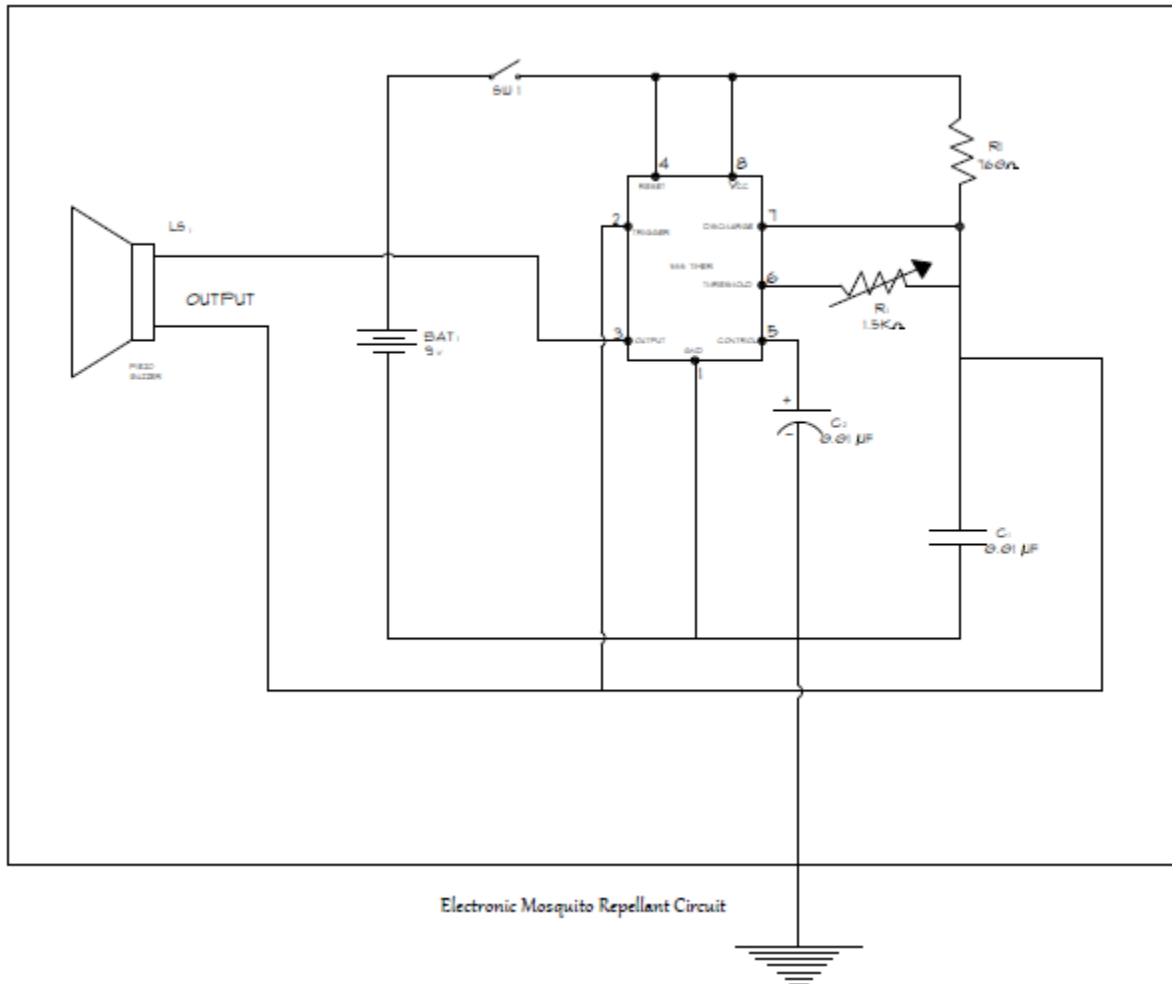


Figure 2: Electronic Mosquito Repellent Circuit Diagram

3.2.1 Design Equations and Computed Values

The components used are: 555 timer, an electrolyte capacitor C_1 of $0.01\mu\text{F}$, a ceramic capacitor C_2 of $0.01\mu\text{F}$, a resistor R_1 of 760Ω , a variable resistor R_2 of $1.5\text{k}\Omega$, piezo buzzer, a SPST switch and a 9 V battery. The design of this circuit is based on the principle of using a buzzer to produce sound at an ultrasonic frequency. An oscillator circuit which is made up of a 555 timer astable multivibrator circuit is responsible for driving the buzzer. Designing the circuit of EMR involves designing the circuit of an astable multivibrator circuit. A multivibrator is an electronic circuit producing a pulsed output signal. Generally multivibrators are classified based on the nature of stability of output. A multivibrator with no stable state is known as an astable multivibrator and is used as an oscillator. Astable multivibrator is also called as Free Running Multivibrator. It has no stable states and continuously switches between the two states without

application of any external trigger. The IC 555 can be made to work as an astable multivibrator with the addition of three external components which are two resistors, R_1 and R_2 and a capacitor, C . Generally, the frequency of the output signal produced by a 555 astable multivibrator is given by:

$$f = \frac{1.44}{C(R_1 + 2R_2)}$$

Where;

R_1 = the resistor between pin 7 and V_{cc} ,

R_2 = the resistor between pin 7 and pin 6,

Let;

$$f = 38 \text{ kHz}$$

$C_1 = 0.01\mu\text{F}$ (i.e. capacitor between pin 6 and ground),

Duty cycle, $D = 60\%$ (It is not possible to 555 timer to produce with 50% duty cycle)

Hence the resistors R_1 and R_2 can be expressed respectively as;

$$R_1 = \frac{1.44(2D-1)}{f C_1}$$

And

$$R_2 = \frac{1.44(1-D)}{f C_1}$$

Substituting the values of C_1 , f and D ;

$$R_1 = \frac{1.44(2(0.6)-1)}{38000 \times 0.00000001} = 758 \Omega \text{ (0.758k}\Omega\text{)}$$

$$R_2 = \frac{1.44(1-0.6)}{38000 \times 0.00000001} = 0.01516 \times 10^3 = 1.52\text{k}\Omega$$

Thus 760Ω can be used for R_1 and $1.5\text{k}\Omega$ for R_2 . Here a potentiometer of $1.5\text{k}\Omega$ is used.

T_C = Charging time or Time at which the output is high

$$= 0.693 C_1 (R_1 + R_2) = 0.693 \times 0.01 \times 10^{-6} (760 + 1500) = 15.66 \times 10^{-6} = 15.66 \mu s$$

T_D = Discharging time or Time at which the output is low

$$= 0.693 R_2 C_1 = 0.693 \times 1500 \times 0.01 \times 10^{-6} = 10.395 \times 10^{-6} = 10.395 \mu F$$

Therefore, the time period of one complete cycle is;

$$T = T_C + T_D = 15.66 + 10.39 = 26.05 \mu F$$

Frequency of charging when the output is high;

$$f_c = \frac{1}{T_c} = \frac{1}{15.66 \times 10^{-6}} = 63.86 \text{ kHz}$$

Frequency of discharging when the output is low;

$$f_d = \frac{1}{T_d} = \frac{1}{10.39 \times 10^{-6}} = 96.25 \text{ kHz}$$

$$\% \text{ Duty cycle at } f_c = \frac{T_c}{T} = \frac{15.66}{26.05} \times 100\% = 60.12\%$$

$$\% \text{ Duty cycle at } f_d = \frac{T_d}{T} = \frac{10.39}{26.05} \times 100\% = 39.88\%$$

3.2.2 The 555 Timer Circuit Connections (The Oscillator Unit)

The 555 Timer IC is the most common type of Astable multivibrator. It is basically an 8 pin IC [18] and it consists of consists of 23 transistors, 2 diodes and 16 resistors [15]. The 555 Timer IC has the following pin connections. Pin 1- is the ground and it is directly connected to the negative terminal of the battery. Pin 2 - Trigger pin. It is an active low pin. The timer is triggered when signal at this pin is less than one third of voltage supply. For astable operation, this pin is connected directly to pin number 6. Pin 3 - It is the output pin. Pin 4 - It is the reset and an active low pin. It is usually connected to the positive rail of the battery. Pin 5 - It is the control pin which is seldom used. For the purpose of safety, this pin is connected through ground to a $0.01 \mu F$ ceramic capacitor to avoid any noise problem. Pin 6 - It is the threshold pin. The timer output is back to its stable state when voltage at this pin is greater than or equal to two-thirds of supply voltage. For astable operation, this pin is shorted to pin 2 and connected to pin 7 using a resistor for stable operation. Pin 7 - It is the discharge pin and provides the discharge path for the capacitor.

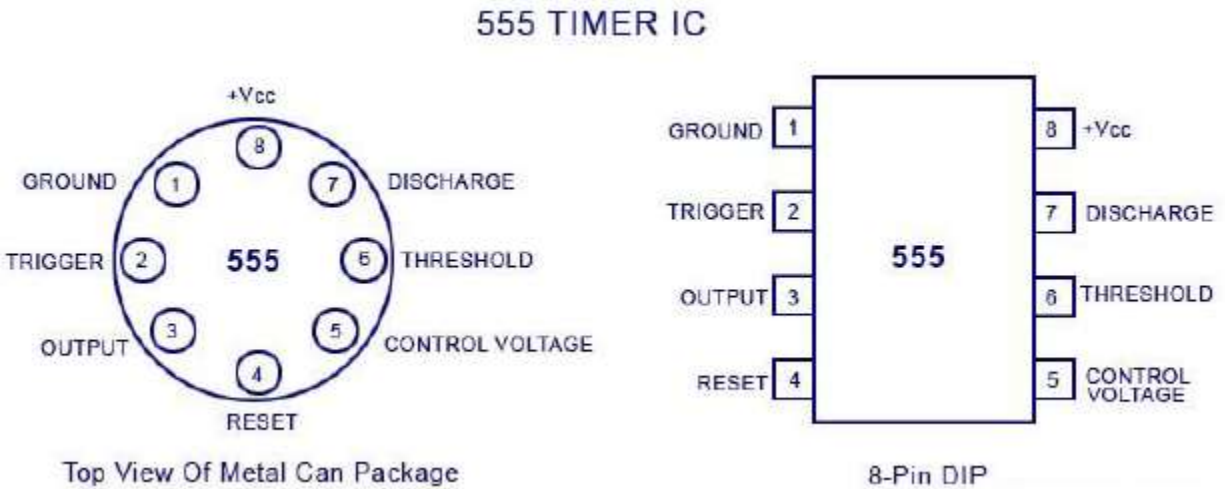


Figure 3: 555 Timer IC Pin Configurations.

Pin 2 and pin 7 of the 555 oscillator circuit are connected together thereby allowing the circuit to re-trigger itself on each and every cycle hence allowing it to operate as a free running oscillator. During each cycle, the capacitor C charges up during both timing resistors, R_1 and R_2 but discharges itself only through resistor, R_2 as the other side of R_2 is connected to discharge terminal, pin 7. Then the capacitor charges up to $\frac{2}{3}V_{CC}$ (the upper comparator limit when the output is high) which is determined by the expression of charge time or time when the output is high, $T_C = 0.693(R_1 + R_2)C$ combination and discharge itself down to $\frac{1}{3}V_{CC}$ (the lower comparator limit when the output is low) determined by the discharged time or time when the output is low, $T_D = 0.693CR_2$ combination [15], [18]. This results in an output waveform whose voltage level is approximately equal to $V_{CC} - 1.5V$ and whose output "ON" and "OFF" time periods are determined by capacitor and resistors combination [23]. The total period of oscillation is $T = 0.693(R_1 + 2R_2) C$ and frequency of oscillation $f = 1.44/C(R_1 + 2R_2)$

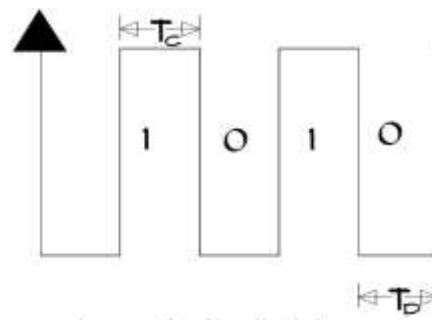


Figure 4: Output waveform of the 555 Timer in Astable Multivibrator Mode

3.2.3 Electronic Mosquito Repellent Circuit Operation

Once the switch of the circuit is closed, the 555 timer gets the power supply. As regards the inner circuit, the capacitor voltage will be zero at the initial stage; hence the voltage at the threshold and the trigger pin will be zero. As the capacitor charges through the resistors R_1 and R_2 , a point is reached where the voltage at threshold pin is less than the capacitor voltage. This causes a change in timer output to a high at $T_C = 0.693(R_1 + R_2)C$.

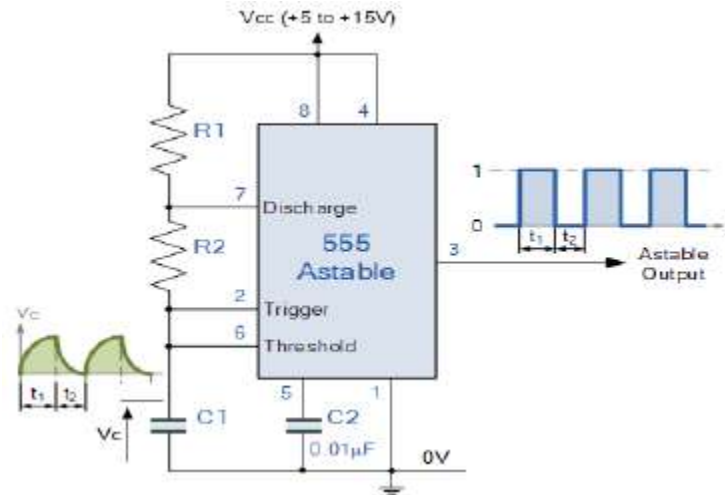


Figure 5: Astable Multivibrator

The capacitor now starts discharging through the resistor R_2 , which means the discharge continues so until the output voltage is back to the original state at $T_D = 0.693CR_2$. This process continuously switches back and forth at a rate depending on the RC network of the circuit [14]. Thus the output signal is an oscillating signal of frequency 38 kHz. The output from this astable multivibrator circuit drives a 38 kHz buzzer, producing ultrasound at regular intervals. The output frequency can also be varied between 20 – 38 kHz by varying the values of the potentiometer R_2 .

4.0 Result and Discussion

4.1 Outdoor Test

This test was conducted in known mosquito breeding ground in the presence of human bait with EMR device TURNED-OFF and observed for 12 minutes. The human bait felt many mosquitoes landing on different parts of his body. It was not possible to determine whether the landed mosquitoes were of the same species or not. The EMR device was TURNED-ON and observed for another round of 12 minutes. In the first 4 minutes 8 mosquitoes were observed to have landed on the human bait. The last 8 minutes

witnessed the landing of only 2 mosquitoes at an average of 1 mosquito for every 4 minutes. The landing rate of mosquitoes with and without EMR ON is different. This indicates the capability of the EMR device in repelling mosquitoes outdoor.

4.2 Indoor Test

The second test was conducted indoor in a closed class room with two human baits. The first human bait was positioned at the centre while the second human bait was positioned at one of the corners of the classroom respectively. The landings of mosquitoes on each of the human baits were observed. In the first 12 minutes with the EMR device TURNED-OFF, the human bait positioned at the middle of the classroom was observed to record the highest number of mosquito landings. The EMR device was placed between the two human baits and then TURNED-ON after the first 12 minutes. The human bait positioned at the centre of the classroom experienced more mosquito landings with most of the landings recorded from the side body of the human bait away from the EMR device. The second human bait positioned at the corner of the classroom experienced few numbers of mosquito landings in the first 4 minutes after which the landing rate drop drastically to zero.

5.0 Conclusion

The results of these tests provided clear evidence from field-based observations that this device had effect on mosquito landing rates. These observations examined the effectiveness of the electronic mosquito repellent on different locations (since the location and environmental conditions may affect the transmission of the Ultrasound). The frequencies of the sound emitted by the device was also adjusted (since mosquitoes may respond to a particular sound wavelength), and times of day (since day-biting and night-biting mosquitoes may behave differently to the sound emitted by the electronic mosquito repellent), and mosquito density (since this may affect electronic mosquito efficacy), but the differences were very subtle and unappreciable. These performance evaluations have revealed that the EMR has capability to repel mosquitoes. The EMR capability is based on 555 Timer which is responsible for the generation of ultrasonic frequency, convert analog voltage signal to digital frequency signal, and in astable multivibrator mode acts as an oscillator to generate clock pulse in a wide range of frequencies with enough output power to drive the IC. In order to control the frequency generated and also make the circuit functioned to generate variable frequencies, a preset resistor and variable resistor have to be included.

References

- [1] Andrade, C.F.S and Bueno, V.S., "Mosquito-Repelling Devices Using *Aedes Albopictus* (Skuce) (Diptera : Culicidae)," *Neotropical Entomology*, vol. 30, no. 3, September, 2001.

- [2] Belton, P., "An Acoustic Evaluation of Electronic Mosquito Repellents," Reprinted from Mosquito News, vol. 41, no.4, pp. 751-755, December, 1981.
- [3] Cabrini, I. and Andrade C.F.S., "Evaluation of Seven Electronic Mosquito Repellers," *Entomologia Experimentalis Et Applicata*, vol. 121, no. 2, pp. 185 – 188, October 13, 2006.
- [4] Chapman, R.F., "The Insects Structure and Function," 3rd Edition, London: Hodder and Stoughton, 1982.
- [5] Curtis, C., "Insecticide – Treated Bed-Nets for Malaria," *Mosquito Control Association*, vol. 22, no. 3, pp. 501 – 506, 2006.
- [6] Devender Krishan, Ultrasonic Pest Repeller, "Electronics for you Magazine", March 2012.
- [7] Dileep Kumar Tiwari and Mamta Alam Ansari, "Electronic Pest Repellent: A Review," 2016 International Conference on Innovations in Information Embedded and Communication Systems (ICIIECS'16) pp. 435-439, March, 2016.
- [8] Enayati, A.A., Hemingway, J., Garner, P.A., "Electronic Mosquito Repellents for Preventing Mosquito Bites and Malaria Infection (Review)", The Cochrane Collaboration. Published by John Wiley & Sons Ltd., 2010.
- [9] Ezeonu, S. O., Amaefule, D. O. and Okonkwo, G. N., "Construction And Testing Of Ultrasonic Bird Repellent," *Journal of Natural Sciences Research*, vol.2, no.9, pp. 8-17, ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online), 2012.
- [10] Foster, W.A. and Lutes, K.I., "Tests of Ultrasonic Emissions on Mosquitoes Attraction to Hosts in Flight Chambers," *Journal of the American Mosquito Control Association*, 1(2), pp. 199-202, 1985.
- [11] Ft Detrick and Forest Glen Annex, Armed Forces Pest Management Board, Information Services Division, Office of the Deputy under Secretary of Defense.
- [12] Helson B. V., and Wright R. E., "Field Evaluation of Electronic Mosquito-Repellers in Ontario," *Proceedings of Entomological Society of Ontario*, vol.1108, pp.59-61, 1977.
- [13] Ibrahim A.G., Oyedun, O.D., Awojoyogbe, and Okeke O.B., "Electronic Pest Control Devices: A Review of their Necessity, Controversies and a submission of Design Considerations" S.S.N. Department of Physics, Federal University of Technology, Minna, Nigeria. *The International Journal of Engineering and Science (IJES)*, vol. 2, pp. 2319 – 1805, 2013.
- [14] Ikeri, H. I., Onyia, A. I., Chima, A.I., and Nwobodo, A.N ., "Construction and Empirical Study of Electronic Piezzo Buzzer Mosquito Repellent," *International Journal of Scientific & Engineering Research (IJSER)*, vol. 8, issue 11, pp. 1605-1610, ISSN 2229-5518, November, 2017. <http://www.ijser.org>
- [15] Introduction to 555 Timer IC, <http://todayscircuits.blogspot.com/2011/06/555-timer-complete-basic-guide.html#.s>
- [16] Jensen, T., Lamp R., Slamecka M.C. and Novak R.J., "Field Efficacy of Commercial Anti-Mosquito Products in Illinois," *Journal of American Mosquito Control Association*, vol.16, no. 2, pp. 148-152, 2000.

- [17] Kurma, R., Insect "Pest Control, Arnold Ltd., Great Britain," 15, 1999.
- [18] Kutz, F. W., "Evaluations of An Electronic Mosquito Repelling Device," Mosquito News, vol. 34, pp. 369-375, December 1, 1974.
- [19] Shagun Jhaver, Rahul Singh, Tejas Hiremani, "Electronic Pest Repellent", EE 318 Electronic Design Lab, Project Report, EE Dept., IIT Bombay, April 2009.
- [20] Simeon M. I., Mohammed A.S., Adebayo S. E., "Development and Preliminary Testing of An Electronic Pest Repeller with Automatic Frequency Variation, "International Journal of Engineering Science Invention(IJESI), vol. 2, issue 1, pp. 14-20, ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726, January, 2013.
www.ijesi.org
- [21] Suchandana R. S., Dhrubojyoti G., Koustuva K. M., "Mosquito Repellent Circuit," International Journal of Engineering and Technical Research (IJETR), vol. 4, Issue 2, ISSN: pp. 2321-0869 (Online), pp. 2454-4698 (P), February 2016.
- [22] W.H.O. 2005. "Global Partnership to Roll Back Malaria World Malaria Report," Geneva: *World Health Organization*; 2005.
- [23] Teja R., " Astable Multivibrator using 555 Timer Circuit, Duty Cycle, Applications,"
Apr. 7, 2021.

“FRESH AIR AND SUNSHINE” GOING BACK TO THE OLD WAYS IN THE FACE OF INFLUENZA PANDEMIC.

Njemanze Izuchukwu William

Department of Science Laboratory Technology

Villanova Polytechnic, Imesi-Ile

Osun State Nigeria.

njemanzeizuchukwu2018@gmail

Abstract

In as much as efforts are being made on development of potent vaccines for the eradication of the influenza currently ravaging the world (COVID-19), it is also pertinent that we look inward and borrow ideas from the past in proffering solutions to the pandemic, and going back the old ways by imploring the natures antibiotics as a measure to remedy the situation is one of the key ideas. Records from the 1918 pandemic showed that a combination of fresh air and sunlight seems to have prevented deaths among patients and infections among health workers. Research has proven that outdoor air is a natural disinfectant, equally sunlight is germicidal, thus both can kill the flu virus and other harmful germs.

Introduction

Fresh air and sunshine are among the oldest, health supporting concepts in medicine. Before the emergence of antibiotics, open air therapy was the standard treatment for infectious diseases. The importance of fresh and sunlight was emphasized by Dr. Arthur Ransome (1834 – 1922). “Abundant fresh air together with sunshine, acts antiseptically upon both the bodies and clothing of patients, destroying all organic impurities which may emanate from either, and so purifying the air that enters the respiratory organs” (R.A. Hobday: 2019)

With the discovery of the chemical antibiotics in the mid – 20th century, there was wide spread hope that this new medicine would eradicate certain diseases. At first, the new medicines seemed to live up to their promise. Yet, their widespread use since then has resulted in bacteria being resistant to them. To find new weapons against infection, scientists are taking a second look at disease control methods of the past. One of which involves harnessing the health benefits of sunshine and fresh air (Dancer 2013, Greenhalgh and Butler 2017).

Open air treatment is the therapeutic use of fresh air and sunshine. In a hospital or sanatorium, this may be done by ensuring good ventilation in an airy, sunny room or by housing patients outdoors in tents or other open forms of accommodation. During the 20th century, such treatment was used for people with infectious respiratory diseases such as influenza or tuberculosis (Hobday and Carson 2009).

Records from 1918 pandemic suggest one technique for dealing with influenza. Medics found that severely ill flu patients nursed outdoors recovered better than those

treated indoors. A combination of fresh air and sunlight played a vital role. Research shows that fresh air can kill the flu virus and other harmful germs.

In 1960s, researchers into biological warfare found that microbes when exposed to outdoor air were killed, but that when they were enclosed, they would remain viable for long. They called this the Open Air Factor (OAF) (Swain Frank 2013). Equally, sunlight is germicidal and there is now evidence it can kill the flu virus (Schuit M et al 2020)

Sunlight

Sunlight refers to the electromagnetic radiation of the sun that reaches the earth, particularly infrared, visible light and ultraviolet light. Sunlight is essential for human health and well being. Researchers have noted a link between exposure to the sun and lower blood pressure levels, with reduced death rates from cardiovascular issues. They suggest that exposure to sunlight triggers the skin to release stores of nitrogen oxides, which cause arteries to dilate, lowering blood pressure, and may reduce the impact of metabolic syndrome. Sun exposure is the most important natural source of vitamin D. The body uses the vitamin to absorb the calcium it needs to build and maintain bones. Additionally, vitamin D plays a key role in optimizing our immunity.

A 2016 study found that apart from its vitamin D making capabilities, sunlight actually energizes T-cells, the immune cells that fight infection. The low levels of blue light present in the sun's rays speed up T-cells movement, optimizing their response to pathogens. When sunlight shines on skin, the nerve endings absorb energy and send it throughout the entire body. A sensible amount of sun exposure nourishes and energizes the human body.

Fresh Air

Fresh air could be defined as the air outside as opposed to that within a room or other enclosed space. The health benefits of fresh air are enormous. Every cell in the body and therefore every function in the body rely upon a constant, fresh stream of oxygen. If one stays indoors or in an air conditioned environment for long period of time, the same air is breathed in again and again, causing the air to become stuffy and stale. Simply stepping outdoors and breathing in some fresh air can have a huge amount of health profits.

By inhaling fresh air, it helps to clear the lungs. This increases the amount of oxygen in the body giving greater energy and also giving the mind greater clarity. Healing from illness and injuries is pretty taxing on the body. Since every cell requires oxygen, it makes sense that replacing damaged cells increases the body's demand for air. While oxygen therapy has been shown to help improve recovery time, fresh air can help one feel better and heal faster too.

Fresh air is crucial for body's metabolism. It strengthens the immune system because white cells need extra oxygen to help beat off bacteria and viruses. Many plants put substances, including organic compound called phytoncides into the air that seem to boost immune function. Breathing in fresh air can help reduce airborne illness and

infection. This is because bacteria and viruses have a reduced chance of survival in fresh air. This is in comparison to warm, humid indoor environment in which they thrive.

Conclusion

One advantage of placing patients outside in the sun is that they can synthesize vitamin D in their skin, which they cannot do indoors. It has been hypothesized that low level of vitamin D may increase susceptibility to influenza (Canell et al 2006). However, more might be gained by introducing high level of natural ventilation in our homes, hospitals and work places, and by spending as much time outdoors as possible. The efficacy of open air treatment has been proven, and one has only try it to discover its value. While we await a potent vaccine to remedy the influenza ravaging the world right now it is also wise that we adopt some measures that include the ones specified by government agencies as well as utilizing that which the nature has given to us.

Refference

- (1) Canell JJ, Vieth R, Umhau JC. Epidemic Influenza and Vitamin D. *Epidemiol infect.* 2006; 134: 1129-1140.
- (2) Dancer SJ. Infection Control in the Post Antibiotic Era. *Healthcare infects.* 2013; 18(2): 51-60 [Google Scholar]
- (3) Greenhalgh I, Butler AR. Sanatoria revisited; sunlight and health. 2017; 47: 276-280 [Pubmed]
- (4) Hobday RA. The open air factor and infection control. *Journal of Hospital Infection* 2019; 103(1): 23-24, doi: 10.1016/j.jhin
- (5) Hobday RA, Carson JW. The open air treatment of pandemic influenza. *American Journal of public Health*(99): 236-242, doi: 10.2105/AJPH. 2008.134627
- (6) Schiut M, Gardner S, Wood S. The influenza of simulated sunlight on the inactivation of influenza virus in aerosols. *Journal of Infection Distribution* 2020; 221(3): 372-378. Doi: 10. 1093/infdis/Jiz582
- (7) Swain Frank. Fresh air and sunshine, the forgotten antibiotics. *New scientist* 2013.

CLEANLINESS IS NEXT TO GODLINESS: IMPLICATIONS FOR EXTRAORDINARY MINISTERS OF HOLY COMMUNION IN THE CATHOLIC CHURCH

OMOJOLA Immaculata Olu, (SSMA), PhD

Department of Business Administration and Management

Villanova Polytechnic

Imesi Ile

Osun State

omojolassma@yahoo.co.uk

Abstract

This paper discussed the proverb- cleanliness is next to godliness as it could be applied to the extraordinary ministers of Holy communion in the Catholic Church. This group is responsible for the distribution of Holy Communion and visiting the sick with Holy Communion, with the approval of the local ordinary in their respective parishes in a given Diocese. They function only when priests and deacons are lacking. Attention was paid in this paper to the fact that these ministers must be attractive in appearance and go for regular Confessions. Integrity and uprightness must be their watch word and they must refrain from satanic worship among others. It was then suggested that reputable people are to be considered for this ministry, regular training should be organized for them and they must be well remunerated. For the purpose of this study, the phenomenological method of inquiry was employed.

Keywords: Extraordinary ministers, Holy Communion, Cleanliness, Godliness, local ordinary and Parish priest.

introduction

This topic- cleanliness is next to godliness which is also called phrase or proverb by some scholars, is familiar at least to those of us who attended various Novitiates in Religious Congregations. It was frequently used by Novice mistresses to emphasize the importance of keeping our environment neat for the purpose of inviting God to dwell with us in our beautiful atmosphere. It also applies to the fact that we have an ethical duty to keep ourselves clean. Cleanliness is used in all faiths and cultures, religious doctrines include various rules that instruct the proper actions of its devotees. For instance, Preston and Ryan (2012) state that in "Judaism, a woman is considered impure for one week after menstruation, and anyone who touches her is also impure until nightfall. Islamic toilet

etiquette requires that one cleanse with water after defecation, and cannot use one's right hand to do so." Therefore, this proverb is not strange to religion.

Olawale (2018) traced the origin of this proverb, and discovered that it was old and very common in Babylonian and Hebrew religious pamphlets. This proverb found its way to English literature in a modified version through the writings of Sir Francis Bacon, a philosopher and a scientist in 1605. However, it was first used in religious sermons in 1778 by John Wesley. Till today, we are using it to state the relationship between our physical appearance, spiritual purity and God.

He went further to define cleanliness as "a quality or state of being clean and also the habit of achieving and maintaining a clean state. Cleanliness can be seen as a moral quality of being clean and free from dirt. On a more practical level, cleanliness is attributed to a hygienic state and the prevention of diseases." p.1. "Habitually kept clean" (Merriam- Webster's Dictionary). Atkinson (2002) describes hygiene and habitually kept clean as washing of hair, creaming of hands and dressing up in neat clothes. This is relevant to what we were taught in our home training and elementary schools. It is actually more than this as it involves washing our body, clothes and making our environments clean.

In defining being godly or Godliness, the idea of remaining pious comes to mind quickly, this is in relation to keeping our vows as religious, attending Masses, reading the Bible regularly and keeping the commandments among others. In living godly lives, the bible in Gen 5: 21-24, wants us to walk with God and to please God as we have it in Gen 11. Godliness is about being devoted to the one true God. This is love in action or devotion in practice. Therefore, as earlier said, our physical appearance, spiritual purity and true devotion will then be translated into action and as I feel, the Ten Commandments must reflect in our lives as we have it in Exod 20: 2-17.

In the New Testament, St Paul describes his responsibility as an Apostle of God in relation to godliness. "Paul, a servant of God and an apostle of Jesus Christ according to the faith of the elect of God and the acknowledging of the truth, which is according to godliness:" (Titus 1:1). In another development, he proclaims "In all things show yourself an example of good works, in doctrine, in integrity, in gravity, the sound word that cannot be blamed: that he who is on the contrary part may be afraid, having no evil to say of us." (Titus 2:7-8) Also, "for the grace of God our Saviour has appeared to all men: Instructing us, that, denying ungodliness and worldly desires, we should live soberly and justly and godly in this world, looking for the blessed hope and coming of the glory of the great God and our Saviour Jesus Christ." (Titus 2: 11-13).

“Seeing then that all these things are to be dissolved, what manner of people ought you to be in holy conversation and godliness? ...Wherefore, dearly beloved, waiting for these things, be diligent that you may be found before him unspotted and blameless in peace.” (1 Cor 3:10-12). These two terms can then be summarized as being clean in body and soul.

Relationship between Cleanliness and Godliness

We must draw the lines between these two terms before appraising their relevance to us as Ministers of Holy communion. McKenzie (1998) states that “it is clear that cleanness means fitness for participation in the cult, and that uncleanness disqualifies one from cultic functions” p.142. It is a pity that this scholar did not discuss how to determine cleanness or uncleanness. Whatever our society or environment abhors should be adopted as unclean. This will enable our people to respond to us and belief in us.

Preston and Ryan (2012) identified the followings as the relationship between these two words:

1. In discussing the relationship between religiousness and cleanliness, each may activate the other as goals for personal purity.
2. Religious doctrines not only prescribe cleaning behaviors that foster physical hygiene, but the act of religious devotion is itself represented as a motivation for spiritual purity.
3. Religious purity rituals are often cited to support the case for the embodiment of morality.
4. Washing and personal cleanliness are integral to many religious rituals, to prepare for contact with the sacred and maintaining the purity of sacred objects.

However, the following bible passages will be of help in identifying the relationship between the two terms.

1. “Since we have these promises, beloved, let us cleanse ourselves from every defilement of body and spirit, bringing holiness to completion in the fear of God.” 2 Corinthians 7:1
2. “Blessed are the pure in heart, for they shall see God.” Matthew 5:8
3. “If we confess our sins, he is faithful and just to forgive us our sins and to cleanse us from all unrighteousness.” 1 John 1:9
4. “Wash yourselves; make yourselves clean; remove the evil of your deeds before my eyes; cease to do evil” Isaiah 1:16
5. “Create in me a clean heart, O God, and renew a right spirit within me.” Psalm 51:10. This is very fundamental to our spiritual growth and to actively participate

in the distribution of the body of Christ. Finley (1997) carefully defines sin as “any action that hurts you, your relationship with other people or the earth. To do any of these things is to damage your relationship with your creator as well” p.110.

Application to extraordinary ministers of Holy Communion in the Catholic Church

Canon 910, paragraph 2 of the code of canon law is explicit on who can be the extraordinary minister of Holy Communion in the Catholic Church. “The extraordinary ministers of Holy Communion is an acolyte, or another of Christ faithful deputed in accordance with canon 230, paragraph 3” p.167.

In an elaborate version, Canon law permits that where the needs of the Church require and ministers are not available, among the lay faithful, even though they are not lectors or acolytes, reputable people could be chosen to exercise the ministry of the word, preside over liturgical prayers, confer baptism and distribute Holy Communion, in accordance with the provisions of the law. (Cf. C. 230 §1-3, Redemption is Sacramentum) (N.B: The term "lay people" does not distinguish between men and women).

The extraordinary minister of Holy Communion can administer Communion only when the priest and deacon are lacking, when the priest is prevented by weakness or advanced age or some other genuine reason, or when the number of faithful coming to Communion is so great that the very celebration of Mass would be unduly prolonged. (A brief prolongation, considering the circumstances and culture of the place, is not at all a sufficient reason). And this is done after the prescribed rites have taken place and with the consent of the ordinary of the place.

Since extraordinary ministers of Holy Communion is responsible for distribution of Holy Communion, helping the parish priest in doing communion service and taking communion to the sick, then, how can this topic/phrase or proverb relevant in this ministry?

1. Appearances must be attractive.
2. Confessions must be regular.
3. Integrity and uprightness must be a watch word.
4. Renouncement of ungodly and worldly desires.
5. Above all, refrain from satanic worship.

Also, remember to keep sacred linens neat since they have direct contact with the Holy Communion.

Suggestions

In line with the above discussions, the following suggestions are offered:

1. That an extraordinary minister must be a man or woman of repute. The world is full of scandals, only those who are making extra efforts to live well should be allowed to belong to this category in the Church. This will enhance the faith of the people and encourage more converts. Hence, emphasis should be laid on the fact that they must be clean and strive to be like God.
2. There should be regular training and re-training for all members to improve their confidence and to also give them a sense of belonging.
3. Parish Priests should be allowed to choose members from their churches to become extraordinary members of Holy Communion, with the approval of the Bishop. This is far better than centralizing the distribution of members to parishes.
4. The parish they are serving should pay attention to their just remuneration.

Conclusion

We have presented the relationship between cleanliness and Godliness in such a way that each may motivate the other as goals for personal pureness. "We need to be clean from Mind, Body, and Soul to make this world a Better place for us and future generations." Khanna (2020). Permit me to conclude with the words of St Paul in 1 Cor 10:31. "Therefore, whether you eat or drink, or whatsoever you do, do all to the glory of God." It is pertinent to keep in mind that you are what you do. By implication, if you partake in the bringing Christ to people, you are not far from becoming a channel that leads others to Christ.

References

- Atkinson S. (2002). Building Self-Esteem, A Practical Guide to Growing in Confidence. Mumbai. Better yourself Books.
- Finley M. (1997). 101 ways to nourish your soul. India. St Paul's Press.
- Khanna A. (2020). Cleanliness Is Next To Godliness. Retrieved 12/11/2020 from <https://www.linkedin.com/pulse/cleanliness-next-godliness-amit-khanna>
- McKenzie L. (1998). Dictionary of the Bible. London. Geoffrey Chapman.
- Olawale J. (2018). Is the phrase "cleanliness is next to godliness" from the Bible? Retrieved 7/11/2020 from <https://www.legit.ng/1134389-is-phrase-cleanliness-godliness-bible.html>
- Preston J.L and Ryan S. R. (2012). Cleanliness and godliness: Mutual association between two forms of personal purity. *Journal of Experimental Social Psychology* 48:1365-1368.
- The Code of Canon Law (1983). Collins

INDUSTRIAL CONFLICT AND ITS EFFECTS ON WORKPLACE EFFICIENCY

Smart Mokuye

Department of General Studies,
Villanova Polytechnic, Imesi-Ile, Nigeria.

smkuye@gmail.com

Abstract

Behavioural and social scientists generally are unanimous on the fact that conflict is inevitable wherever there is some opportunity for choice-making in settings that bring people together to achieve certain goals or objectives. Whether at inter-personal, group, workplace or at larger society levels, conflict should normally be expected, because certain disagreements must necessarily occur, as humans, by nature are bound to reason and act differently. This article therefore, examined industrial conflict and its effects on workplace efficiency, with a view to fashioning ways and means of its effective management. This is considered from the following three points' objectives, namely: an assessment of the concept of conflict; evaluation of the effects of conflict in an industrial setting; measurement of industrial conflict solution, and suggestions on the management of industrial conflict. The paper made use of primary and secondary sources of data collection, and was analysed with descriptive and content analyses. The study findings revealed that, the flow of work in organisations may be affected adversely by protracted conflicts at workplace, especially on the level of performance, and attendant multiplier effects on level of production, sales volume and rate of turnover per time. The paper concluded that, though industrial conflicts are said to be inevitable, efforts and strategies can however be put in place by top management of organisations to mitigate and checkmate their occurrences.

Keywords: Conflict, Industrial conflict, Conflict Solution Measurement, Conflict Management

1. Introduction

Conflict refers to more than just overt behaviour. Concentrating only upon its behavioural manifestation is an extremely limiting exercise. The three-dimensional conceptions of conflict emphasises the need to consider the situation in which parties (individuals, groups or organisations) come to possess incompatible goals, their structure of interaction and the nature of their goals. Emotional (e.g. distrust) and cognitive (e.g. stereotyping) orientations that accompany a conflict situation as well as the range of actions undertaken by any party in a situation of conflict should be considered.

Conflict generally can be viewed as the result of disagreement in behaviour among people having identical goals, stemming mainly from variations in levels of reasoning, thinking, perceptions and an innate desire to advance interests that are directly of benefit to an individual. It is the result of refusal or failure on the part of individuals to see things

with the same lenses with another or others. Conflict sets in whenever there are variations or deviations in the mindsets of those who, ordinarily, should align towards the achievement of set goals. Whether intra-personal, inter-personal, intra-departmental or inter-departmental, humans are at the background of every conflict situation. In other words, human make ups, behaviours, actions and in-actions are what give rise to conflicts which accentuates to an industrial or organisational dimension.

Organisations are living systems consisting of interacting units performing a task in a mutually dependent manner within a structure of scarce resources. It seems commonplace to suggest that conflicts would be present in such a setting. The parties in an organisation may have a conflict about the distribution of resources, or have a more fundamental conflict about the very structure of their organisation and the basic nature of their interactions. Once the parties are in a situation of goal incompatibility, their conflict develops in a dynamic fashion, initiating valuable and much-needed constructive changes or leading to escalating strategies and destructive consequences. As there is nothing pre-determined about its course or development, it seems erroneous to view conflict from a negative perspective only, as destructive or dysfunctional. It is true that conflict may be uncomfortable, it may even be a source of problems, but it is absolutely necessary if change is to occur, or organisations are to survive and adapt. Organisational change and innovation do not just happen, it requires a stimulant. That stimulant is conflict.

Managers must accept the need to influence the developmental dynamics of a conflict, so that the parties' attitudes and actions will lead to better co-ordination and a more appropriate inter-dependence. They must not seek to stifle or eliminate organisational conflict, for that is hardly a realistic goal. As *Rico* (1964) has noted, an organisation devoid of conflict "... may indicate autocracy, uniformity, stagnation and mental fixity." It would also be protecting only the vested interests of the status quo. Managers must accept and indeed occasionally encourage conflict, because change and other desirable consequences are products of conflict. The challenge which managers face is to utilise such conflict management techniques that would ensure that as a conflict passes from a latent to a manifest phase, it proceeds towards its potential and realises its constructive values.

Behavioural and social scientists alike are of the opinion that, conflict is rampant in all social lives. They see it as an inevitable part of living because it is related to situations of scarce resources, division of functions, power relations and role-differentiation. They argue that, due to its pervasive nature, the concept had acquired a multitude of meanings and connotations presenting us with nothing short of a semantic jungle. Like other terms, conflict generates considerable contradiction and leaves many scholars and Managers quite uncertain about its meaning and relevance as well as how best to cope with it.

If conflicts are not effectively managed or controlled, they result in crisis or outright violence. Hence, this article particularly emphasised the negative effects of conflict in an organisation, and underscored efforts towards resolution and averting

recurrences both to strengthen workers' confidence in the organisation and for the goal of the organisation to be met.

2. Literature Review

Research into Organisational Behaviour can be divided into two categories, namely: *normative* and *descriptive*. Normative research is concerned with how things should be, whereas descriptive research addresses itself to what is – rather than what could or should be. This dual perspective is most apparent in approaches to the issues of conflict and its measurement and management in organisations. Normative approaches reflect attitudes and beliefs which identify all conflicts as destructive and promotes conflict-elimination as the formula for organisational success. Descriptive approaches on the other hand accept conflict as inevitable and considers its proper management as the primary responsibility of all Managers. This paper aligns itself with the descriptive mode of inquiry in presenting a framework for the study of conflict in organisations. But it goes beyond this domain in suggesting that Managers must take the offensive and seek to manage conflict, and also in advocating a paradigm shift from the traditional methods of dealing with conflict to a new and more sophisticated approach.

2.1. Definition of Conflict

The normative conception of conflict, strongly influenced by a pre-occupation with stability and equilibrium in organisational design, links conflict to violence, destruction, inefficiency and irrationality. This form of intellectual short-sightedness was especially unpleasant in suggesting that Managers have the responsibility of avoiding, controlling or eliminating conflict. Descriptive approaches challenge the whole basis and rationale of these assumptions. They permit us to depart from an outmoded paradigm by suggesting that any social interaction in which the parties (however they may be structured or defined) compete for scarce resources or values has the potential for conflict. Using the term in a broad sense, it can be suggested that conflict refers to all kinds of antagonistic interactions. More specifically, it can be defined as a situation in which two or more parties have incompatible objectives and in which their perceptions and behaviour are commensurate with that incompatibility. This definition is purposely broad. It suggests that conflict is a social phenomenon that is found in personal, group or organisational interactions. As such, it comprises several dimensions.

In measuring solution in organisational conflict, *Fink (1968)* distinguishes between antagonistic-psychological relations and antagonistic behaviour, whereas *Pondy (1967)* observes that conflict is made up of antecedent, affective, cognitive and behavioural conditions respectively. We advance a conception of conflict which emphasises its three, inter-related dimensions, namely: *conflict situation* (the basic incompatibility), *conflict attitudes* (range of psychological factors) and *conflict behaviour* (set of related behaviours).

2.2. Conceptual Clarifications

The paper herewith attempts a clarification of concepts that are rather prominent and/or germane to the study as follows:

2.2.1 Analysing Industrial Conflict

From a Behavioural Science argument perspective, three distinct criteria define the role of a manager in an organisation, namely: planning, resource allocation and conflict management. There is no doubt that managing conflict permeates every aspect of the administrative or managerial roles. Awareness of the various forms of conflict management that can be employed at different stages of the development of a conflict is vital, if managers are to organise efforts towards influencing the conflict situation, the parties' attitudes or their behaviours. Furthermore, effective conflict management requires a recognition of the sources that generate a conflict. What, then, are the sources or bases of organisational conflicts?

2.2.2 Sources of Conflict

Organisational conflict appears in a variety of forms and has varying causes. These can generally be separated into several categories. Katz (1964) identifies three sources of conflict. These, according to him are: *structural conflict* (conflict arising out of the need to manage the inter-dependence among different organisational sub-units), *role conflict* (conflict arising from sets of prescribed behaviour) and *resources conflict* (conflict stemming from interest groups competing for organisational resources). Robbins (1974) on his part, also identifies three other sources of organisational conflict and indicates that an understanding of the source of a conflict improves the probability of effective conflict management. According to him, the main factors which serve as sources of conflict are: *communicational* (conflicts arising from mis-understandings etc.), *structural* (conflicts related to organisational roles), and *personal* (conflicts stemming from individual differences). It is however important to state that, methods of conflict management which are appropriate in one case may not necessarily be appropriate when applied to a conflict generated from another source. Here, a different perspective which traces the source of organisational conflict to the unit of analysis involved may be suggested.

Units of Analysis are the parties to a conflict. They perceive, initiate and sustain a conflict. Their characteristics specify the conditions which affect the course of a conflict and determine the mode of its management. Thus, there are conflicts that originate in the individual person (*intra-personal*), conflicts that have their basis in the relationship between individuals (*inter-personal*), and conflicts that occur as a result of interactions between groups within an industrial setting (*group or inter-departmental*) conflicts respectively. Each of these categories raises different questions about the three inter-related components of conflict and emphasises different aspects of conflict management.

2.2.3 Intra-personal Conflict

Intra-personal conflict is internal to the individual, yet its effects can profoundly influence organisational functioning, and perhaps the most difficult form of conflict to measure and manage. Intra-personal conflict is basically a conflict between two incompatible tendencies. It arises when a stimulus evokes two different and incompatible tendencies and the individual is required to discriminate between these tendencies. In such a situation it is common for individuals to experience frustrations and to allow their conflict situation to be expressed in a range of behavioural strategies ranging from apathy and boredom to absenteeism, excessive drinking or destructive behaviours. If such behavioural consequences are to be avoided, then it is essential to diagnose individual perception and utilise some techniques that would reduce anxiety-eliciting stimuli and increase consonance between individual behaviour and organisational requirements.

2.2.4 Inter-personal Conflict

Inter-personal conflict emphasises the interaction of human factors in an organisation. Here we are concerned with these factors as they appear in a dyadic relationship. Two classes of factors can broadly be suggested here as conflict sources. These are: Firstly,

Personal. Individuals are not identical, constant or consistent. When two individuals are brought together and kept together, each with his own qualities, needs and skills, a conflict may ensue if their attributes are not meshed together in a co-ordinate way. Interaction between individuals with different attitudes, values and needs can produce conflict behaviours and affect organisational performance. The second class of factors as conflict source here also is:

Functional. Individuals in organisations have roles which are expected and sets of behaviour associated with their position. In theory, individuals are not expected to engage in any discretionary behaviour. Such specification would be consistent with organisational preferences for consistency and predictability. In practice, however, role specifications tend to be ambiguous and incomplete, and in their interaction with others, some individuals often feel dissatisfied with their role or position, or they may feel that their aspirations for higher positions are being frustrated. Inter-personal conflict can be accounted for, to a great extent, in terms of the incumbents' roles and their expectations in particular situations.

2.2.5 Inter-departmental Conflict

The third major cause of organisational conflict is structural. Organisations are designed around product lines, regions or technical specialties. These activities are assigned to departments that often have mutually exclusive structured interests and goals and that interact within a framework of scarce resources and task dependence. When resources are relatively fixed and when one department's gain is at the expense of another, conflict should be expected. If two sub-units in an organisational system have differentiated goals

and are functionally inter-dependent, conditions exist for conflict. Inter-dependence produces the need for collaboration, but it also presents occasions for conflict.

Other contextual factors which affect the interaction structure between departments and create the conditions for inter-departmental conflict include: different attitudes between line and staff units, organisational size (directly related to level of conflict) and standardisation (inversely related to conflict), physical or communicational barriers between departments, unequal access to authority, rewards or organisational resources and ambiguity or uncertainty in assigning tasks or rewards to different departments. These, then, are the sources of conflict situations in organisations. How a conflict situation will change over time, how its inter-related components will alter and the environment in which it occurs will respond, is dependent upon the manager's efforts to manage or influence it. This, in turn, is related to one's understanding of the source of a specific conflict situation.

2.3 Theoretical Framework

This study is hinged on the popular *conflict theory*, which was first purported by *Karl Max*. The theory states that society is in a state of perpetual conflict because of competition for limited resources. The theory holds that social order is maintained by domination and power, rather than by consensus and conformity. According to this theory, those with wealth and power try to hold on to it by any means possible, chiefly by suppressing the poor and powerless.

Conflict theory examines any social phenomenon through the lens that, there is a natural human instinct towards conflict. *Marx* is not saying that, conflict is good or bad, but rather, that it is an unavoidable aspect of human nature and that it helps to explain why things are the way they are. For example, conflict theory can be used to look at wars, violence, revolutions and forms of injustice and discrimination by explaining that there is a natural disparity in societies (and individuals) that causes these problems. A basic premise of conflict theory is that individuals and groups within society will work to try to maximise their own wealth and power (*Marxists Internet Archive. Manifesto of the Communist Party*. Accessed August, 10, 2020).

In the current research, where workplace (industrial) conflict is examined, the theory establishes the fact that, conflict is inherently inevitable either at, intra-personal inter-personal, inter-departmental levels because issues and opinions would obviously and always differ both at the top, middle and lower management levels. With this consciousness, managers at different levels of the organisation have to take necessary steps both to identify areas of conflict, mitigate and put strategies in place to manage them. This is because protracted conflict in an organisation or workplace setting tend to either slow down the pace of performance or outrightly cause a total breakdown in the flow of work.

This article thus provides the various ways of management of conflicts, whether at inter-personal, intra-personal, inter-departmental levels respectively. At the intra and

inter-personal levels, Blake & Mouton's five possible modes of conflict management, namely: withdrawal, smoothing, compromise, forcing and problem-solving comes handy, while at the inter-departmental level, the following methods are suggested: conflict avoidance (separating departments by re-locating them physically), regulating a conflict by introducing new rules and procedures, seeking a form of "legalistic" solution (by appealing to higher organisational authorities), using departmental representatives to reach a compromise agreement or seeking mediation or arbitration from an outside body.

2.4 Empirical Review

This study is made with robust empirical review on some of its vital aspects as follows:

2.4.1 Measuring and Managing solutions in Industrial Conflict Management

Ways of measuring and managing organisational conflict are as varied as its causes, origins and contexts. The purpose of conflict management, whether undertaken by the parties in conflict or whether involving the intervention of an outside party, is to affect the entire structure of a conflict situation so as to contain the destructive components in the conflict process (e.g. hostility, use of violence) and help the parties possessing incompatible goals to find some solutions to the conflict. Effective conflict management succeeds in minimising disruption stemming from the existence of a conflict, and providing a solution that is satisfactory and acceptable. We describe efforts directed towards containing or limiting some aspects of behaviour as *strategies of conflict settlement* and efforts directed towards the parties' attitudes, situations as well as behaviour as *strategies of conflict resolution*. Skilled managers are aware of these methods and techniques and know how to utilise them effectively.

All organisations, however simple or complex, possess a range of mechanisms or procedures for managing conflict. These are built into the organisational structure and are consciously employed by managers to influence the course and development of a conflict. The success or effectiveness of such procedures can be gauged by the extent to which they limit conflict behaviour and the extent to which they help to achieve a satisfactory solution. It is the contention of this article that strategies of conflict avoidance, conflict prevention or institutionalisation of conflict will change or replace co-ercive behaviours, but that only the injection of a behavioural social scientist, acting in a facilitative, non-directive and non-evaluative fashion, will achieve a resolution with respect to the basic issues, attitudes and structure of interaction. If managers care for optimal methods of conflict management, they should give their strongest support to a strategy that can end a conflict in a satisfactory and self-perpetuating manner. All this is not to contend, however, that conflict resolution is the immediate outcome of any intervention.

The outcome of a conflict depends upon many aspects of the conflict process prior to the efforts to manage it (e.g. issues in conflict, relative power of actors, degree of proximity etc.). What is being suggested here is that if four basic conflict outcomes may

be distinguished — namely: withdrawal, imposition or dominance, compromise and a creative, problem-solving resolution — then the most likely mode by which outcome may be reached pertains to the voluntary intervention of an outside consultant acting as a professional helper.

2.4.2 Measuring and Managing Intra-personal Conflict:

Intra-personal conflict is predicated upon an incongruity between individual needs and organisational requirements. Intra-personal conflict unfolds over time and manifests itself in a complex and multiform range of attitudinal and behavioural consequences. These may vary from psychosomatic consequences (e.g. frustration, emotional instability) to physical consequences (e.g. absenteeism, destructive behaviour). As such consequences are obviously correlated with decreased performance and work-motivation. Managing intra-personal conflict will help the individual to promote his capacity for adaptation and attain an equilibrium in his relationship with the organisation. Personal existence is, inevitably, punctuated by conflicts and other emotionally charged experiences.

Meanwhile, in *Henri Fayol's* suggested 14point' principles to managers of organisations on the best way possible to have an effective management of an organisation, he recommended, *inter-alia*, a subordination of individual interests for general or organisational interests. In other words, organisational interests should take prominence over and above personal or individual interests. However, where a person experiences an inner conflict and feels that he cannot master his situation, or change his environment, a number of methods of conflict management can be employed. These are conveniently divided into *cognitive* and *behavioural* strategies respectively. Cognitive strategies, often called *defense mechanisms*, help an individual to falsify, distort or deny a particular conflict. Cognitive strategies represent an attempt to control or manage negative and disturbing feelings associated with conflict and to allow an individual to carry on with his normal activities. Cognitive strategies include repression (an attempt to push conflict out of existence), rationalisation (hiding the truth from oneself), fantasy or even denial of reality. *Behavioural* strategies for coping with intra-personal conflict include escape, withdrawal and aggression (especially against convenient targets). It should be stated however, that, these strategies cannot resolve intra-personal conflict in any permanent way. Rather, they can be successful in the short-run. They can help an individual to reduce his level of anxiety and diminish his tension. They can prevent or avoid disruptive behaviour, but they cannot generate a solution. This can come about through the involvement of an expert consultant, acting in an accepting manner and encouraging the individual to evaluate his situation rationally and decide upon more effective responses.

Interventions in intra-personal conflicts entail consideration of substantive issues, discussions and self-observations, helping an individual to unload his burdensome thoughts and reactions and reorienting his thinking towards a more benevolent and self-

maintaining pattern of behaviour. The strength of this approach to conflict management is that it helps an individual to concentrate on his situation and on ways to evaluate alternatives that may have gone unnoticed. The consultant remains detached from an individual, but his intervention, listening, probing, interviewing and explicit confrontation of the conflict issues, sets the basis for self-diagnosis and improved performance. It eliminates distortion and increases self-knowledge. It is a method which seeks not merely an amelioration of the surface symptoms, but a successful change in the situational (e.g. reevaluating a conflict situation), attitudinal (e.g. reduced anxiety, increased self-esteem) and behavioural (e.g. stimulate productive behaviour) components of a conflict. Consultants may be internal to an organisation, or they may be introduced by an administrator when circumstances require it. They have several roles to play, all intended to aid a person to be more effective in his organisation.

What characterises all these roles are that they are enacted in an informal and flexible fashion and in a facilitative and diagnostic manner. Techniques which are congruent with implementing the consultant's role include: *facilitative techniques* (e.g. facilitating individual exploration and self-observation, giving information, advice, reassurance and encouragement), *behavioural modification techniques* (e.g. establish, through negative or positive reinforcement, contingencies of behaviour that should be decreased) and *cognitive techniques* (e.g. learn to undo old values and acquire a new perception of the self). When organisations experience difficulties as a result of intra-personal conflicts, managers would be well-advised to manage such conflicts by leading their organisations to seek professional help from persons who are trained to fulfil the role of organisational consultants. Successful organisational change does, after all, depend upon a strong commitment to conflict resolution.

2.4.3 Managing Inter-personal Conflict:

Inter-personal interactions are extra-ordinarily complex. Individuals are brought together and kept together because of personal attraction or complementary needs. A great deal of individual behaviour takes place in organisations (academic institutions such as universities, polytechnics, etc; hospitals, factories) in which they occupy various positions. Such positions are inter-locked or inter-dependent so that the attitudes and behaviours of one individual affect the attitudes and behaviours of another. Indeed, we may describe organisations as networks of repetitive, reciprocal and predictable interactions between individuals. Although persons in an organisation interact in a relatively consistent way along a stable-cooperative dimension (organisations develop norms to ensure stable interactions), inter-personal conflict is an essential aspect of organisational life.

The causes of inter-personal conflict in organisations can be ascribed to *personal* (interaction between dissimilar people maximises conflict potential), *perceptual* (individuals perceive an unfair allocation of organisational resources) and *functional* (conflicts arising from incompatible role requirements) differences respectively. On the

whole inter-personal conflict generates new ideas and work patterns, but when it is augmented by personal distrust, misperception and competition, it can very easily be transformed into destructive and costly behaviour. To avoid detrimental effects on individual as well as organisational functioning, managers need to identify the causes of inter-personal conflict and take appropriate action to deal with it.

Following *Blake & Mouton*, one can suggest five possible modes of conflict management, namely: withdrawal, smoothing, compromise, forcing and problem-solving. *Withdrawal* is an attempt to manage inter-personal conflict by avoidance. *Smoothing* involves emphasis of common, organisational interests and yielding by one or both parties. *Compromise* is an attempt to manage conflict by expecting each person to give up something. *Forcing* occurs when inter-personal conflict is managed in a fashion which compels one person to comply. *Problem-solving* is an attempt to achieve close collaboration and integrative decision-making between individuals.

Empirical support for the notion that problem-solving is the most effective method for dealing with the underlying problem and feelings of inter-personal conflict and generating a sound resolution may be obtained from a number of studies. *Lawrence & Lorsch* examined the use of the various conflict management methods in six organisations and concluded that the highest performing organisations used problem-solving to a greater extent than other organisations. *Burke* asked seventy-four (74) managers to describe the way they dealt with conflicts and, in comparing scores of constructive conflict management, found that the most effective ones used problem-solving methods (followed by smoothing and compromise in that order).

In a second study, he compared fifty-three (53) descriptions of effective conflict management. With fifty-three descriptions of ineffective conflict management from fifty-seven (57) managers and found that 58.5% of statements about effective conflict management related to problem-solving (followed by 24.5% for forcing and 11.3% for compromise). Organisations that can increase the use of problem-solving in inter-personal conflict can offer a better working experience, more constructive consequences and a more creative conflict resolution.

Problem-solving as a method of conflict management is not a common experience. A number of elements or conditions have to be present if it is to be realised. These conditions appear to be as follows: situational requirements (e.g. informality and flexibility of interactions, absence of time pressures, power symmetry etc.); attitudinal requirements (e.g. trust and confidence in each other, belief in conflict resolution rather than conflict avoidance etc.); perceptual requirements (e.g. individuals do not perceive threats or need to win or dominate the other), and behavioural requirements (e.g. free information, definition of issues, discussion of alternatives, exhaustive search for solutions, etc.). On the whole, these requirements are absent in dyadic conflict management where individuals' responses are as likely to escalate as to reduce conflict. The implication of this is that parties outside the dyad must intervene to alter the fundamental parameters of individual interactions in organisations and to introduce the conditions which are suitable to problem-solving.

The intervention of a behavioural consultant, either from within or outside the organisation, can achieve this goal. Consultation-based approaches to inter-personal conflict focus on understanding the psychological and operational environment of an individual, utilising behavioural scientists in a supportive-facilitative way and promoting the establishment of problem-solving. Interventions by behavioural consultants may take the form of offering theoretical inputs, e.g: providing individuals with conceptions about conflict; offering content observation, e.g: suggesting various outcome interpretations, and offering process observations, e.g: increasing productive interactions through openness, synchronisation of efforts, etc. They give individuals the freedom, opportunity and motivation to move away from rigid behaviour or from reiterating their positions as prescribed by organisational norms. They address themselves to the attitudinal and behavioural dimensions of interactions and in combining task and socio-emotional activities, they exemplify and help to establish the conditions of problem-solving. In contrast to other methods of conflict management, the intervention of a behavioural consultant accentuates the positive and highlights commonly held views of the actors.

The applications of this approach in the inter-personal sphere rest upon the following assumptions: Firstly, differences in perceptions are the main causes of inter-personal conflict; secondly, barriers to improved information prolong and aggravate a conflict, and thirdly, inadequate interactions between individuals prevent them from managing their conflicts constructively. Techniques of intervention in inter-personal conflict are closely related to these assumptions and include: perceptual, informational and interactional procedures respectively. Perceptual procedures involve identifying conflict issues, defining alternative issues, and "reality-testing". Informational procedures involve clarifying issues, encouraging and gathering information (through interviews, meetings or other instruments), and increasing frequency, openness and accuracy of communication. *Inter-actional* procedures entail regulating the pace of interaction, offering "process" observations to help individuals see how to be more effective, injection inputs in the form of concepts, models or principles which might be useful in understanding a conflict and helping in the design of implementation steps through which conflict resolution would be possible.

Through his intervention a behavioural consultant becomes the information-gathering instrument and a "resource person". Managers who are concerned about organisational change and more productive results would be well advised to be aware of the strengths as well as limitations of this approach to inter-personal conflict management.

2.4.4 Measuring and Managing Inter-departmental Conflict:

Conflict between departments is a natural consequence of organisational activities. As organisations move towards greater differentiation and complexity, as they change or adapt to new circumstances, the stage is set for incompatibility of goals or competition for scarce resources. The resulting conflict between departments may have uncertain

consequences for an organisation. On the one hand it may have a dysfunctional and counterproductive effect on the organisation, and on the other hand it can be highly functional and stimulate intra-organisational creativity. For conflict to be a vehicle for organisational growth and creativity, there must exist an appropriate method of conflict management between departments. A manager should know when he is faced with inter-departmental conflict and be informed of the processes for coping with it or resolving it.

Attitudes and Behaviours which Characterise Inter-departmental Conflict:

These can be described in terms of the following categories:

1. *Effects within Each Department.* When departments are in conflict, individual members tend to bury their differences and display greater loyalty to their department. Departments become more cohesive, more formal in their behaviour and more insistent upon individual conformity and accomplishment of prescribed tasks.

2. *Effects Between Departments.* Each department begins to experience perceptual distortions and to develop a strong self-image and a negative stereotype of the other. With the rise of prejudicial attitudes between departments there is an increase in hostility and a decrease in communication. Each department strives to enhance its own image and performance and to downgrade the other's. Under such conditions a conflict becomes a matter of victory or defeat, winning or losing. The fundamental significance of a win-lose dynamics is that it is, to some degree, intrinsic to any complex and stratified organisation, but that feelings of in-group versus out-group are especially strong in conflict situations. The attitudinal characteristics of such a pattern include a competitive orientation, the evaluative characteristics include antagonistic feelings and the behavioural characteristics include circumscribed interaction and distorted communication. The structural attributes of a conflict relationship must be considered in proposing a strategy of conflict management.

Traditional approaches to managing inter-departmental conflict emphasised such methods as: conflict avoidance (separating departments by relocating them physically); regulating a conflict by introducing new rules and procedures; seeking a form of "legalistic" solution (by appealing to higher organisational authorities); using departmental representatives to reach a compromise agreement or seeking mediation or arbitration from an outside body. Such conflict management methods may indeed produce an agreement. They may reduce the level of conflict behaviour between departments and even legitimise new levels of performance. They cannot, though, achieve a genuine conflict resolution because they merely reflect, perpetuate and occasionally aggravate a win-lose pattern of interactions.

Separation, withdrawal, institutionalisation, bargaining or legal approaches are essentially forming of a win-lose confrontation. They all start with a polarised, adversary orientation, in which each department tries to attain as much as possible by outsmarting the other. They bury a conflict, ignore it, produce power-based decisions or allow

departments to withdraw from it. They do not stimulate a search for conflict resolution. A range of new approaches to managing inter-departmental conflict may be suggested. These approaches acquire new significance because they become integral parts of an interaction process between departments, because they move away from win-lose type of strategies and because they can meet the need for conflict resolution more effectively. They are best summarised in terms of the social psychologists out of whose experiments these approaches evolved: Sherif *et al* suggest two broad strategies which are designed to increase co-operation between departments, facilitate mutual communication of needs and minimise the effects of hostility and negative attitudes. Both strategies are broad in their scope. Their targets of change is the organisational structure, but changes in individual attitudes and improvement in inter-personal competence may also be involved.

1. Locating a Conflict Common Enemy: When departments are engaged in a conflict, their incentive structure (i.e. of interest) may be changed and a mutual understanding as well as favourable attitudes may be promoted if they perceive a threat from a competing organisation. Shifting the level of inter-departmental conflict to the higher level of inter-organisational conflict will produce a new structural relationship within each organisation, a relationship that would harness departmental efforts and help them to compete more successfully against another organisation. The perception of an external threat or the identification of a common enemy supersedes any conflict that departments within an organisation may have. As a strategy of conflict management within an organisation, it operates on two levels. First, it affects individual attitudes, perceptions and feelings of trust and distrust. Second, it influences organisational role structure. It transforms interactions which are characterised predominantly by differentiation to accommodative interactions of a collaborative and integrated orientation.

2. Locating a Superordinate Goal: Superordinate goals are goals which are greatly desired by several departments and can only be achieved by combining the energies and resources of all involved. The introduction of a superordinate goal (e.g. developing a new product-line which would attract great customer demand) will create a cooperative context in which departments may interact on problems of joint interests, develop favourable attitudes and seek to achieve solutions that are mutually satisfactory. The introduction of a superordinate goal converts a conflict between departments to friendly interactions. The logic of introducing a superordinate goal is related to the very definition of a conflict. If conflict develops from the perception of incompatible goals, then cooperation would be promoted from common goals. To be successful in resolving inter-departmental conflict, a superordinate goal must be of such importance that departments can forget their differences and work together. It must involve several episodes considering the time dimension and it must be introduced by a third party.

The cumulative efforts of developing cooperative activities are an important determinant of successful conflict management between departments. *Blake & Mouton* accept that the most important aspect of a successful conflict management strategy is the

attempt to shift the behavioural and attitudinal components of a relationship from a competitive to a cooperative orientation. They do, however, suggest that both the common enemy and the superordinate goal approaches fall short of the need to achieve a genuine conflict resolution. This is because both can be seen as, one, being mainly temporary in character; two, both are primarily defensive, and three, both strategies may widen a conflict by externalising it. They offer an approach which emphasises consultation-based interventions, openness of communication, greater participation in decision-making and problem-solving interactions.

Blake & Mouton accept that traditional conflict management strategies can only deal with the behavioural component in conflict and bring about a patchwork solution. They suggest an approach to conflict management which involves interventions by organisational consultants (usually applied behavioural scientists), who have no vested interest in the conflict itself, but who have the competence and experience to generate a productive mode of conflict management. They avoid the pitfalls of adjudicating or evaluating which department is "right" or "wrong" (so often the hallmark of traditional conflict management). Nor do they seek to impose a solution. They intervene in order to generate creative thinking and to establish a problem-solving attitude. Consultation-based approaches to inter-departmental conflict accept conflict situations as inevitable and see them as useful occasions which permit departments to disagree and to work out the disagreements and ultimately to understand each other better.

The general functions of a consultant usually consist of: avoiding power-based outcomes; providing knowledge and skills regarding conflict processes; inducing an emotional-cognitive change as a prelude to collaborative interactions and providing a supportive, informal and learning environment well-suited to creating the requirements conducive to problem-solving. The technologies of consultation consist of educational activities and techniques, laboratory training observations, survey-feedbacks, questionnaires and interviews. The structure of consultation activities is so designed as to engage individuals as whole persons, not merely as segmented individuals striving to cope with their role demands.

Conflict Management, and indeed all forms of organisational behaviour, is determined by the interaction of *information, skills, values* and *situation*. Each of these factors acts as antecedents of some consultation-based activities. Behavioural consultants provide parties in conflict with more information and an understanding of the complexities of conflict interactions. They promote social interaction skills (which should be recognised as important as technical skills). They promote values of cooperation and help to create a situation in which people can interact freely and feel that they are as important to an organisation as are its resources or products. The sequence of consultation activities commences with upgrading individual skills and abilities, moves on to team-building activities and then to restructuring inter-group and inter-departmental activities. The institutionalisation of these activities consists of four steps. The first step — *bringing in the consultant* — represents an administrative response to a felt need for effective conflict management. The second step — *entry* — is associated with

various information-giving activities. The third step is aimed at *attitudinal change through data-feedback, team-training, sensitivity and T-Group training or Grid development*. The final step involves *a structural change in the relationship between departments and a move towards integrative interactions and conflict resolution*.

Effective conflict management is quite a major undertaking. There are not too many guideposts to indicate where we are or how to move towards conflict resolution. It is, therefore, a task which demands attention to attitudinal and behavioural elements, to outcome and emotional needs and to inter-personal as well as inter-departmental requirements. The intervention strategies of a behavioural consultant can, we have argued, move us towards that direction. We cannot be certain that the intended effects will always be achieved. We can suggest, with some certainty, that such interventions move us forward in the direction of effective conflict management and success in problem-solving. With this consideration in mind, managers should encourage such interventions and help to produce more effective programmes.

3) Methodology

The paper made use of primary and secondary sources of data collection, and the same was analysed with descriptive and content analyses. The primary sources utilised include questionnaire administration, conduct of in-depth interviews and direct observation. Three Hundred and sixty (360) questionnaires, being the sample size, representing 30% of the population of One Thousand and Two Hundred (1,200) purposively selected from four different organisations, namely: Joint Professionals Training Supports (JPTS) International, Ile-Ife, Osogbo, Ilesa, and Ikirun Centres (all in Osun State), Faculty of Administration, Obafemi Awolowo University (OAU), Ile-Ife, and Ibadan Electricity Distribution Company (IBEDC), Ilesa Business Hub. each accounting for One Hundred and Twenty (120) respondents' questionnaires.

In-depth interviews were conducted on Twenty (20) respondents in each of the organisations to corroborate information obtained from questionnaire administration. Those selected both for questionnaire administration and interviews were those deemed experienced and exposed enough in their respective organisations to provide adequate information to serve the purpose of this research and appreciate the fact that conflict is an issue in organisations and solution needed to be proffered to it especially if the goals of the organisations is to be realised.

4) Discussion on Findings

The study findings revealed that, the flow of work in organisations are affected adversely by protracted conflicts at workplace. Furthermore, companies' level of performance is grossly affected by it, with attendant multiplier effects on level of production, sales volume and rate of turnover per time.

The organisations utilised for this study, responded rather unanimously, that, there are some pockets of conflict, which they claimed have been affecting their performances. The

JPTS, Ile-Ife, Osogbo, Ilesa, and Ikirun Centres (all in Osun State), with relatively low workers' strength on each Centre basis, seem to have issues with their headquarters in Lagos. Their grievance centred around poor staff welfare. Virtually all lecturers in the identified Centres complained of poor remuneration and delay in its payment. They furthered complained that students are more or less pampered and placed over and above lecturers. The non-academic staff on their part complained of preferential treatment for their academic staff counterparts. Investigation revealed that, salaries which are made at the end of semester, are sometimes paid far into the next semester. Furthermore, evidence revealed that discipline is lacking, and students were in the habit of reporting lecturers to their respective Co-ordinators. Investigation further revealed that, even the headquarters planted spies in each Centre to make confidential reports to it on lecturers and Co-ordinators. On poor remuneration, the study revealed that lecturers, regardless of their qualifications, are paid #15,000 (Fifteen Thousand Naira only) per course per semester. This along with the other issues of lack of discipline and that lecturers and Coordinators are at the mercy of students, has caused conflict in the Centres identified.

In the Faculty of Administration of OAU, Ile-Ife, there has been a rather protracted case of inter-personal conflict. There could be inter-departmental issues, among the faculty's four departments (Accounting & Management, International Relations, Public Administration, and Local Government Studies) the current study is on inter-personal issues within the faculty: lecturers versus lecturers, lecturers versus other staff, lecturers versus students, Heads of Departments (HODs) versus other lecturers, and students. In particular, the study examined inter-personal conflict among lecturers across departments, the cumulative effect of which had been strained relationship, names calling, and above all low or reduced productivity of individual lecturers.

The IBEDC, Ilesa Business Hub, though a private sector organisation, is serving members of the public of Ilesa and its environs. The study revealed that this dual-purpose status of the organisation, is the cause of the conflict with the public. Whereas the sector has been privatised, the members of the public still expect it to function as a public utility organisation as in the days of ECN, NEPA and PHCN. Respondents revealed that, sometime in 2018, there was outbreak of violence between some segments of the city and the power organisation resulting in wanton destruction of the organisation's valuables and beating up of some members of staff.

Under the prevailing influence of behaviourism, inter-personal conflict management has been directed mainly towards the behavioural components of a conflict situation. Attitudes and perceptions have been considered beyond the realm of conflict management. As a result of this, conflict management has tended to force individuals to choose between fixed and simplified behavioural alternatives, defined in terms of two rigid behavioural goals, winning or losing. The choices and incentives associated with this orientation of victory versus defeat were strongly constrained, forcing individuals into relatively primitive modes of interaction and providing managers with an untrustworthy vehicle for potential conflict management. Of the five methods of managing inter-personal conflict, it appears that problem-solving is the only method that is directed towards the attitudinal, situational and behavioural components of conflict. It is the only method that does not focus on relatively automatic,

unthinking responses. It is the only method which seeks to utilise higher mental processes to achieve a high-quality, integrative and satisfying outcome.

5) Concluding Remarks

Organisations are social entities segmented into hierarchies of departments and individuals. The basic realities of organisational life cannot but stimulate comparisons, competitions and conflicts between departments and individuals. Conflict is an omni-present feature at each of these organisational levels. Since conflict may have functional as well as dysfunctional consequences, it is essential that managers explore various methods and techniques of conflict management. Effective conflict management is indispensable if co-ordinated efforts and productive achievements are to result. I have suggested above that the planned intervention by behavioural scientists represents the most effective method since it can produce organisational change and a sense of personal accomplishment. A wide range of intervention activities may be utilised to deal with conflicts at various organisational levels.

It is however beyond the scope of this work to provide a manual that can possibly foresee all the contingencies or to evaluate the effectiveness of different types of intervention. Rather, the paper purported to view conflict management as an integral part of an organisation. Managers should be able to ascertain the presence of a conflict, its basic sources, the level at which it manifests itself, its degree of intensity and the ways of furthering the objectives of conflict resolution.

From a pragmatic viewpoint manager should direct their attention to four issues, namely: Is there a conflict? Where is the conflict? Does it require to be managed? How best to implement an effective conflict management strategy? With these issues in mind, the main features of this article may be summarised by developing a conceptual framework for conflict management in organisations. Conflict and conflict in organisations have only recently begun to receive the attention it deserves. In this article I have sought to address ourselves to the determinants of conflict and the effectiveness of different methods of measuring and managing solution in industrial conflicts and management. conflict.

The article finally concluded that, though industrial conflicts are said to be inevitable, efforts and strategies can be put in place by top management of organisations to mitigate and checkmate their occurrences

6) Recommendations/ Suggestions for Further Research.

Though conflicts can be inevitable, and as this study pointed out, for purposes of peace and effective work performance, efforts have to be made to stem the tide of conflicts. The following suggestions which also serve as points for further research, are recommended:

- The organisation's goals should be clearly communicated and understood by all workers.
- Lines of authority and responsibility should be clearly defined and understood.
- Effective workers' welfare should be put in place.
- Personal interests should not be raised above organisational goals and interests.

- Private organisations should have and operate a functional staff welfare scheme.
- Workers should be made to undergo trainings where they will understand such things as individual differences and other work ethics.
- There should be adequate public awareness on the present status of especially the Distribution sub-sector of the electricity industry.
- Capable hands on conflict management matters should be consulted to handle workplace conflicts.
- Work remuneration should be based on individual merits of staff and should be on equal ratings with their colleagues elsewhere.
- Managers of organisations, who should double as Behavioural Scientist, should study and understand workers' behaviours and adopt interim measures to mitigate workplace crisis.

References

- Assael, H (1969) "Constructive Role of Inter-organisational Conflict", *Administrative Science Quarterly*, 14 (4,1969), 499-505;
- Aubert, V (1963) "Competition and Dissensus", *Journal of Conflict Resolution*, 7 (1,1963), 26-42.
- Boulding K.E. (1957) "Organisations and Conflict", *Journal of Conflict Resolution*, 1 (2, 1957), 122-134.
- Boulding K.E. (1962) *Conflict and Defense: A General Theory* (New York: Harper and Row, 1962).
- Boulding & L. Kriesberg, (1973) *Organisations and Conflict: The Sociology of Social Conflict* (Englewood Cliffs, N.J.: Prentice Hall, 1973).
- Brown J.S. (1967) "Principles of Intrapersonal Conflict", *Journal of Conflict Resolution*, 1 (2, 1967), 135-154
- Corwin R.G. (1969) "Patterns of Organisational Conflict", *Administrative Science Quarterly*, 14 (4, 1969), 507-520.
- Deutsch M (1973) *The Resolution of Conflict*. (New Haven: Yale University Press, 1973) K. Singer (1949) "The Meaning of Conflict", *Australian Journal of Philosophy*. 27 (3, 1949), 141-157. 2.
- Deutsch M (1969) "Conflicts: Productive and Destructive", *Journal of Social Issues*, 25 (1, 1969), 7-42.
- Dutton J.M. & R.E. Walton, (1966) "Interdepartmental Conflict and Cooperation: Two Contrasting Studies", *Human Organisation*, 25 (2, 1966), 207-220.
- Fink C.F. (1968) "Some Conceptual Difficulties in the Theory of Social Conflict", *Journal of Conflict Resolution*, 12 (4, 1968), 412-460.
- Ferguson K.C. (1968) Concerning the Nature of Human Systems and the Consultant's Role, *Journal of Applied Behavioural Science*, 4 (2, 1968), 179-193.
- Galtung J. (1969) "Conflict as a Way of Life" in *Progress in Mental Health*, ed. by H. Freeman (London: Churchill, 1969) and elaborated in Mitchell, op. cit.
- Handy C.B. (1976) *Understanding Organizations*. (Harmondsworth, Middx.: Penguin, 1976)
- Janis & L. Mann (1977) *Decision Making* (New York: The Free Press, 1977).
- Katz, D (1964) "Approaches to Managing Conflict", in *Power and Conflict in Organisations*, ed. by R.L. Kahn and K.E. Boulding (New York: Basic Books, 1964), pp. 105-114.
- Katz D & R.L. Kahn (1976) *The Social Psychology of Organisations* (2nd ed.; New York: Wiley, 1976)

- Kelly, J (1969) *Organisational Behaviour*. (Homewood, Ill.: Dorsey Press, 1969).
- Kelly J (1970) "Make Conflict Work for You", *Harvard Business Review*, 48 (July-August, 1970), 103-113;
- Litterer, J.A. (1966) "Conflict in Organisation: A Re-examination", *Academy of Management Journal*, 9 (September, 1966), 178-186
- Mack, R.W. (1965) "The Components of Social Conflict", *Social Problems*, 12 (4, 1965), 388- 397.
- Mitchell, C.R. (1981) *The Structure of International Conflict* (London: Macmillan, 1981).
- Patterson, C.H. (1974) *Relationship Counselling and Psychotherapy* (New York: Harper and Row, 1974);
- Pietrofessa, J.J. *et al.* (1978) *Counselling: Theory, Research and Practice* (Chicago; Rand McNally, 1978);
- Pondy, R.L. (1967) "Organisational Conflict: Concepts and Models", *Administrative Science Quarterly*, 12 (2, 1967), 296-320.
- Rico L (1964) "Organisational Conflict: A Framework for Reappraisal", *Industrial Management Review*, 5 (Fall, 1964), 67.
- Robbins, S.P. (1974) *Administrative Science Quarterly*, 14 (1, 1969), 73-84;
- Schmidt S.M. & T.A. Kochan (1972) "Conflict: Towards Conceptual Clarity", *Administrative Science Quarterly*, 17 (3,1972), 359-370.
- Thomas K.W. & W.H. Schmidt, "A Survey of Managerial Interests with Respect to Conflict", *Academy of Management Journal*, 19 (2, 1976), 315-318.
- Thompson, J.D. "Organisational Management of Conflict", *Administrative Science Quarterly*, 4 (4,1960), 389-409. 121
- Walton R.E. & Dutton J.M. (1969) "The Management of Interdepartmental Conflict: A Model and Review", *A Managing Organisational Conflict: A Non-Traditional Approach* (Englewood Cliffs, N.J.: Prentice-Hall, 1974).
- Walton, R.E. *et al.* (1969) "Organisational Context and Interdepartmental Conflict", *Administrative Science Quarterly*, 14 (4, 1969), 522-542;

LYCORINE: PROSPECTIVE NATURAL CURE FOR ZIKA VIRUS INFECTION

Umoke Toochukwu

Villanova Polytechnic

umoketoochukwu@gmail.com

Abstract

In 2007, an epidemic of dengue-like illness ravaged the isolated island of the yap, federated state of Micronesia, located in the western pacific. Afterward, the centre for disease control and prevention (CDC) ascertained that the outbreak was as a result of the infection of a positive sense single stranded RNA arbovirus designated as 'Zika virus'. This viral infection has an adverse complication on the children and pregnant women. In the latter, it can lead to preterm birth and miscarriage. Although this pathogenic arbovirus represent a serious health burden in tropical and sub-tropical areas worldwide no therapeutic agent to protect susceptible individual age the viral infection is in existence; therefore, inhibitors of Zika virus are therefore needed. A benzyl phenethylamine alkaloid denominated as 'lycorine' has shown to exhibit some medicinal qualities such as anti-cancer, anti-plasmodial, anti-inflammatory, inhibition of hepatitis C virus replication and so others. Furthermore, studies have indicated that lycorine is capable of restraining the rdpd activities of Zika virus. Due to its potency and ability against Zika virus infection in vivo and in vitro, lycorine might offer promising therapeutic possibilities for combating the pathogenic virus in the near future.

Introduction

Zika virus disease is a zoonotic ailment induces by the infection of a susceptible host by Zika virus. Zika virus is an arbovirus from the flaviviridae family; the mosquito-borne virus was first isolated from a rhesus monkey in the zika forest of Uganda in 1947 (**Chen H., et al 2020**). Identification in human was in 1952 in Uganda and the United Republic of Tanzania (**World Health Organisation 2018**); the virus made its way into Nigeria in 1967. Zika virus is a positive sense, single stranded RNA virus transmitted to humans by mosquitoes. The virion is approximately 44mm in diameter with surface projection that measures roughly 5-10nm. The viral nucleocapsid is 25-30nm in diameter surrounded by a host-membrane derived lipid bilayer. Zika virus genome encodes three structural proteins (C, prM/M and E) and seven non-structural (NS) protein (NS1, NS2A, NS2B, NS3, NS4A, NS4B, AND NS5) (**Sirohi D., et al 2017**).

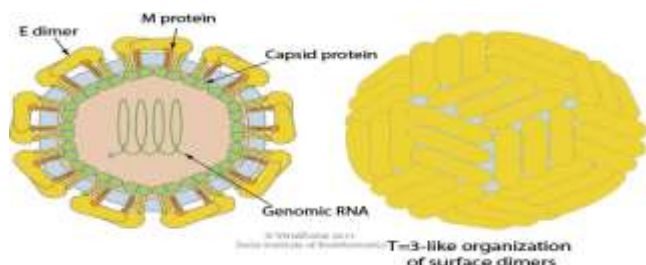


Figure1: diagram of zika virus

Zika virus is transmitted to people primarily through the bite of an infected *Aedes* species mosquito (*Ae. Aegypti* and *Ae. Albopictus*); these are same species of mosquitoes involve in the spread of dengue and chikungunya viruses. *Aedes spp.* Typically lay eggs in or near standing water, in things like buckets, bowls, animal dishes, flower pots and vases. They prefer to bite people and live indoors and outdoors near people; unlike anopheles mosquitoes, aedes spp. bite during the day. In addition to the arthropodean mode of transmission, ZiKV can also be transmitted from mother to fetus, through sexual intercourse, blood transfusion and also through laboratory and healthcare setting exposure (Centre for Disease Control, 2019).

Although, ZiKV infection leads to mild disease among some infected patients, adverse complications are evident in children and pregnant women. In the latter, it can spread to pregnancy defect such as fetal loss, stillbirth and preterm birth. In infants, zika virus infection can result to congenital zika syndrome; this syndrome includes microcephaly (a condition where baby's head is smaller than expected); brain damage and reduced brain tissue; eye damage; joint problem; limited motion; reduced body movement due to too much muscle tone after birth. In older children and adults, ZiKV infection is a trigger of Guillaine-Barre syndrome, neuropathy and myelitis. Amidst these adversities and complications, there are no therapeutic agent and vaccine to protect susceptible individual against the virus.

Nevertheless, nature has always been a perfect housing for the advent of promising therapeutic agents. Lycorine is a crystalloid alkaloid found in various Amaryllidaceae species such as the cultivated bush lily (*Clivia miniata*), surprise lilies (*lycoris*), and daffodils (*Narcissus pseudonarcissus*) (Lycorine, 2020). Lycorine is the major active component in lycoris, a represent of traditional Chinese medicine herb, and is one of the typical alkaloids with pyrrolophenanthridine nucleus core (Cao Z., et al 2013).

The benzyl phenethylamine alkaloid was first isolated from *Narcissus pseudonarcissus* in 1877 (Chen H., et al 2020); subsequently, it has been isolated and identified from alkaloids of other medicinal amarrylidaceous plants like *Lycoris radiate*, *Leucojun aestivum*, *Hymenocallis lithoralis*, *Ammocharis coranica*, and *Brunsvigia radulosa* (Cao Z., et al 2013).

Structure of Lycorine

Structurally, lycorine is composed of molecular ring system derived from L-phenylalanine and L-tyrosine with a single nitrogen atom. Lycorine alkaloids have a typical pyrrolophenanthridine nucleus structure. The full chemical name of lycorine is 2,

4, 5, 7, 12b, 12c-hexahydro-1H-(1,3) dioxolo(4,5-j)-pyrrolo (3,2,1-de) phenanthridine-1-diol, and its molecular formula is $C_{16}H_{17}NO_4$ with the relative molecular mass of 287.31.

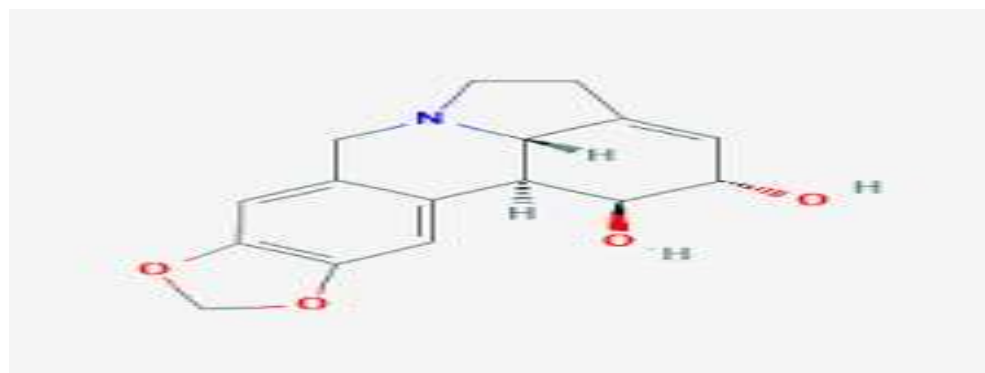


Figure 2: chemical structure of lycorine

The alkaloid is a colorless prism crystal with the melting point of about 260-262°C and it is very stable and can be preserved at room temperature for about 3 years. Lycorine is immiscible to the wastewater and insoluble in ether and alcohol. The hydrochloride form of lycorine is a needle-shaped crystal with the melting point of about 217°C.

Medicinal Properties of Lycorine

Based on accumulated evidence, lycorine have proven to exhibit multiple biological activities and pharmacological effects such as, anti-leukamia, anti-tumor, anti-angiogenesis, anti-virus, anti-bacteria, anti-inflammation, and anti-malaria (Cao Z., et al 2013). Lycorine has demonstrated its potentials to inhibit acetylcholinesterase and topoisomerase, suppression of ascorbic acid biosynthesis and control of circadian period. In addition, Lycorine inhibits growth of several *Saccharomyces cerevisiae* strains rho+, rho-, and mit-; whereas the strains devoid of mitochondrial DNA are resistant to lycorine at concentration of more than 200 µg/mL, suggesting mitochondrial genes are involved in the anti-bacterial effect of lycorine. Mechanism studies show that lycorine blocks the viralRNA replication and suppresses the viral protein synthesis. Lycorine strongly hinders RNA synthesis in flaviviruses and weakly inhibits viral protein translation. A gene allele substitution of viral 2K peptide in lycorine-resistant West Nile virus (WNV) confers the virus resistance to lycorine via an enhancement of viral RNA replication. Lycorine also inhibits the incorporation of [3H]leucine into poliovirus-infected HeLa cells and partially abolishes protein translation in the cells in a dose-dependent manner, implying that lycorine may impede protein synthesis in virus infected cells. Lycorine blocks the protein synthesis of the 3'-terminal region of the polyvirus translation unit, but not affect the protein synthesis of either 5'-terminal or middle region of the polyvirus translation unit. In addition, lycorine can completely protect mice from pathologic symptoms upon a low-dose EV71 virus challenge through blockade of virus polyprotein elongation during translation. Ribonucleoprotein (RNP) complex plays a pivotal role in

the viral generation and replication. Amaryllidaceae alkaloids do not affect the activity of the RNP complex, however, Amaryllidaceae alkaloid hemanthamine can suppress the migration of RNP from nuclear to cytoplasm, and lycorine delays the export of nucleoprotein protein from the nucleus. Collectively, lycorine is a potential candidate drug for anti-virus therapy.

Anti-Viral Activity of Lycorine on Zika Virus

According to the result of laboratory experiment conducted by Huini Chen and his team of scientist “qRT-PCR and plaque forming assay revealed that lycorine inhibits intracellular RNA synthesis and extracellular virion formation”. At a minute concentration of 0.5um, lycorine partially inhibited plague formation; complete inhibition was attained at concentration of 5um. Western blotting indicated that lycorine treatment caused a dose-dependent reduction in ZiKV protein, and envelope biosynthesis was significantly reduced in lycorine-treated cells in a concentration dependent manner.

Table: cell cytotoxicity and activiral of lycorine

Cell line	CC ₅₀ (μM)	Lycorine EC ₅₀ (μM)	SI
Vero	21	0.39	54
A549	4.29	0.22	19.5
Huh7	4.4	0.22	20

Source: the table was drafted from the result of Chen H., et al, experiment

The table above demonstrates the cytotoxic concentration 50% (CC50) values and 50% inhibition concentration (EC50) values in Vero (African green monkey kidney), Huh7 (hepatocellular carcinoma cells) and A549 (human alveolar basal epithelial adenocarcinoma) cells; it indicates that lycorine is a potent inhibitor of ZiKV infection in multiple cells.

Time of addition assay was used to clarify which step of ZiKV life cycle is affected by lycorine. The qRT-PCR results showed that 1um lycorine displayed the strongest ability to decrease the vRNA and viral progeny particle between -2 and 10hpi. Analysis of the infectious viral proteins in the cells revealed that lycorine reduced viral protein synthesis, which coincides with post-entry event of ZiKV replication cycle. Therefore, indicating that lycorine interfere with the translation and replication of vRNA. Futhermore, lycorine targets the synthesis of both positive and negative-strand RNA. Quantification test revealed that the levels of both positive and negative sense vRNA were decreased in lycorine treated cells compared to control cells. Lycorine inhibited – and + vRNA synthesis with efficacy of approximately 95% and 93% respectively. This observation suggests that lycorine inhibits the synthesis of positive and negative chains during viral replication.

CETSA was carried out to examine the direct interactions between lycorine and NS5. Tagg values of NS5 in Vero cell lysates were measured in the absence or presence of lycorine at temperatures ranging from 33 to 53.8 °C. The CETSA showed that lycorine treatment increased the thermal stability of NS5, markedly increasing the Tagg of the NS5 protein from 44.6 to 47.8 °C. These results confirmed that lycorine binds directly to NS5 and protects it from thermally induced aggregation.

Moreover, in vitro RNA assay confirmed that lycorine directly inhibits RdRp activity in a dose-dependent manner. In mice, ZiKV group displayed 100% mortality rate when treated with lycorine.

Conclusion

ZIKV infection is a serious threat to global health, and there are currently no approved drugs or licensed vaccines available for the prevention or treatment of ZIKV infection. Lycorine has divergent chemical structure and multiple biological functions and pharmacological effects, including anti-tumor, anti-tumor neovascularization, anti-virus, anti-bacterial, anti-inflammatory, anti-parasite, anti-plasmodia, and inhibition of ascorbic acid biosynthesis. The result of **Chen H., et al** experiment has proven lycorine to be an essential and effective arsenal against Zika virus infections.

Reference

- Cao Z., Yang P., and Zuou Q., Oct 2013; '*Multiple Biological Functions and Pharmacological Effects of Lycorine*'; Science China Chemistry, vol.56; no.10: 1382-1391
- Centre for Disease Control and Prevention 2019; U.S Department of Health and Human Services; accessed on Dec. 14th, 2020; <<http://www.CDC.gov/zikv/index.HTML>>
- Chen H., Lao Z., Xu J., et al (2020); '*Antiviral Activity of Lycorine Against Zika Virus in Vivo and in Vitro*'; Elsevier; Virology 546 (2020) 88-97, <www.Elsevier.com/locate/virology>
- Lycorine (2020, Dec. 5th). In Wikipedia, <<https://en.m.wikipedia.org/wiki/Lycorine>>
- Sirohi D., and Kuhn J.K., '*Zika Virus Structure, Maturation and Receptors*'; the Journal of Infectious Disease, Infection Society of America, HIV Medicine Association; 2016:216
- World Health Organisation 2018, accessed on June 13th, 2020, <<http://www.who.int/newsroom/fact-sheets/detail/Zika-virus>>

PHYSICS OF FAILURE AND ITS ROLE IN MAINTENANCE

IDOKO SUNDAY AGADA

DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY,
VILLANOVA POLYTECHNIC, IMESI-ILE,
OSUN STATE NIGERIA.
SUNNEX105@GMAIL.COM

Abstract

The majority of the challenges in the field of maintenance are associated to failures and their prevention. Understanding why, when and how components fail should therefore play an important role in many aspects of maintenance management and engineering. The key issue of maintenance is finding the optimal balance between minimizing the effects of failing (sub-) systems on the one hand, and minimizing the maintenance costs on the other. For critical systems, where failures have serious consequences in terms of costs, safety, environmental effects or consequential damage, measures are generally taken to prevent such failures from occurring and spending a considerable budget on preventive maintenance is then justified. However, for many critical applications in the industries, company, organization, military, aerospace and nuclear power sectors, this risk avoidance has resulted in a very conservative maintenance approach. Many components are replaced far before they reach the end of their actual service life. Maintenance programmes are then effective (in preventing failures), but not very efficient.

Keywords: maintenance, components, failure, preventive.

Introduction

Any electronic instrument or piece of equipment can be considered as a system. A system can be defined as “anything formed of component parts connected together to make a regular and complete whole”.

An instrument or piece of equipment can have sub-systems made in blocks to perform specific functions. These sub-systems are made-up of electronic circuits, which are forms of electronic/electrical or electromechanical component parts. The failure of a component in an equipment may lead to the failure of the system. Failure is said to be the inability of a system to perform its required function. The need for continuous performance of an equipment requires that it is given regular maintenance. It is, therefore imperative that the meaning of maintenance is well understood.

Maintenance

Maintenance, in general, can be defined as efforts taken to keep the condition and performance of a machine always like the condition and performance of the machine when it is still new. Maintenance activities can basically be divided into two parts: planned maintenance activities and unplanned maintenance activities.

Planned maintenance is maintenance that is organized and carried out with thought to the future, control and recording in accordance with the plans that have been determined previously.

The type of maintenance cannot be equated for each equipment, which depends on the method, cost and critical level. This is all the activities carried out on an equipment in terms of proper installation, good servicing, routine checks, repairs and replacement of faulty parts in order for such equipment to operate at its maximum output throughout its useful life. An equipment or instrument is considered to have failed when under any of these conditions:

- a. when it becomes completely inoperative
- b. when it is still in operation but unable to perform the required function any longer
- c. When it becomes unsafe for its continued use.

Maintenance Strategy

This is a plan or scheme put in place by a person responsible for maintenance to ensure that the exercise is effectively carried out and does not result in the total breakdown of activities in an organization. If carefully constructed it will help in applying maintenance practices which will most effectively care for the equipment. This will prolong the working life of the equipment and reduce the need for spare parts.

Types of Maintenance

There are five different types of maintenance and these are as follows:

1. Fixed Time Maintenance

This is servicing of an equipment periodically at regular intervals. The particular maintenance requirements will probably vary with the level of service. For example, the requirements for 12 monthly service will be different for those for 3 monthly.

2. Condition Based Maintenance

This type of maintenance requires the use of human senses to know when it is needed. In the course of operating an equipment one may see signs of smoking, electrical sparks, feel for excessive heat, smells for signs of burning and some others. The condition at which the equipment is will necessitate that it should be opened up immediately for maintenance. This act will assist in preventing further damage. Some more complex systems have sensing devices built in to them, and alarm systems to detect variation from the norm.

3. Opportunity Based Maintenance

This is carried out when an equipment is opened up for repairs and this opportunity is used to do any other maintenance tasks which are due in the near future, such as routine servicing and the replacement of any parts which are at the end of their useful life. Also, the opportunity can be used to replace a broken part which had occurred before opening the equipment but had no effect in its operation.

4. Design-Out Maintenance

This maintenance type is used on an equipment which has a part that is failing regularly due to an apparent design weakness. It may be possible to upgrade the weak part and effectively change the design for the better. If a particular part is not available one may be able to change the design to allow a more common part to be used. In spectrophotometry, for example, it may be possible to modify a simple car headlamp bulb to enable it to function as a tungsten source.

5. Operate to Failure Maintenance

These are cases whereby an equipment is not given general routine care but it is allowed to fail before any other maintenance is attempted. This is widely used on electronic equipment which normally are not just taken to a mechanic for servicing while still functional. They are only opened up when they have broken down. This means that an equipment is operated to failure before it is opened up for maintenance.

Planned Maintenance Scheme

This is a strategy that is put in place to ensure that all equipment receive the most appropriate type of maintenance at the right time. It can be defined as “work carried out with forethought control and records”.

The planned maintenance policy for any organization must be carefully considered and planned in advance. It must include records which are compiled and maintained to measure the result of maintenance and to serve as a guide to the future planning.

Establishing A Planned Maintenance Scheme

1. Take inventory of all items to be maintained. Reference each item with a letter to indicate its location. A simple exercise book may be used with each item having its own page in the book, or a card system may be employed with each item having its own card. The entry should include all relevant technical details on the item.
2. Describe the maintenance tasks which are to be performed. This may be achieved by listing the tasks to be completed at each scheduled maintenance point. This is normally done in a maintenance Record Card.
3. Finally, wherever any maintenance is carried out on a piece of equipment a record of what has been done must be kept. This may be a form of job report specifying date, fault detected, cause.

Classification of Maintenance

The type of maintenance cannot be equated for each equipment, which depends on the method, cost and critical level. The following types of maintenance methods are commonly used in several industries.

- Preventive Maintenance
- Predictive Maintenance
- Corrective Maintenance
- Breakdown Maintenance

i. Preventive Maintenance:

This is the practice or arrangement whereby a piece of equipment or instrument are regularly checked, oiled, greased or cleaned according to manufacturer's specification for effective performance. This maintenance method is normally carried out at a specified time of a year and in that case the entire working system is shut down. Fund is normally provided to ensure that spare parts and some other materials meant for such maintenance are provided. The essence of this form of maintenance is to ensure that the equipment does not break down and thus performs to specification.

ii. Predictive Maintenance:

Predictive maintenance is a method for doing maintenance by replacing parts based on predictions using a tool. The point is if the preventive method is only based on the schedule, then the predictive method is based on the results of the measurement.

This method can also use the five senses, for example in bearing inspection can be distinguished from the sound produced. Or checking temperature, by touching it we can feel the difference or abnormality of the equipment.

Examples: Tachometer, to measure the rotation of the Thermometer, to measure the temperature of the Ampermeter, to measure amperage

iii. Corrective Maintenance

This method is applied to an equipment that has failed and thus broken down due to either improper operations or a defective part. It is concerned with the detection, location and repairs of faults as they occur. This requires a good understanding of system fault location methods in addition to an understanding of overall system and circuit operation. In addition to equipment, it is also intended for parts that have a short life cycle (reduce the frequency of damage) and speed up repair time.

In other words, this method is to extend MTBF (Mean Time Between Failure) and accelerate MTTR (Mean Time To Repair) because of its reliability (activity to prevent recurrence of damage) and maintainability (activity to speed up repair time).

Example: The operator has difficulty checking the oil volume of the generator engine, so improvisation is done by making a measuring cup equipped with a scale.

iv. Breakdown Maintenance

It is a method where inspection and replacement of parts are not carried out, so with this method we leave the equipment damaged and then we fix it or replace it. Usually this method is applied to equipment / machines with consideration:

Equipment is only optional (additional) so that if it is damaged it does not interfere with production

The cost of repairing / replacing cheap parts

Insignificant damage

Easy and fast repair

Total productive maintenance (TPM):

Total productive maintenance is a maintenance activity that involves production operators in maintaining equipment / machinery in addition to activities carried out by maintenance operators.

Examples are cleaning, lubricating, tightening nuts & bolts, daily checking (checking equipment / machine state), simple repairs (replacing leaking hoses, welding tips) etc.

The objectives of the TPM are:

Develop operators that are able to detect damage signals as early as possible. Because it is the production operator that really knows the state of the equipment to even the most detailed part.

Creating a neat, clean workplace so that any irregularities can be detected as early as possible.

Maintenance Procedure

Maintenance procedures that should be considered when preparing the planned maintenance program include:

1. Carrying out repairs needed when plant or equipment breaks down;
2. Predicting, from a history of breakdowns, the life expectancy of parts, bearings, etc., the tasks to be carried out and the frequency to be established;
3. Checking the condition throughout the plant of equipment, its running hours, readings of different responses (e.g. vibration, temperatures, current, etc.);
4. Monitoring the operating cycle and, where appropriate, seasonal shutdowns of plant, equipment (e.g. production process, 24-hour duty, etc.).

Maintenance systems

The benefits to be accrued from the implementation of a program of planned maintenance can be found in the efficient and economical operation of the plant and equipment and the utilization of resources (i.e. plant and equipment and manpower) while also maintaining a sound standard of safe working and environmental conditions for operators, other occupants and employees within the workplace. Maintenance systems vary, depending on the location of the plant and equipment and/or company policy. Systems can range from the complete maintenance of plant and equipment using all available methods to their replacement on failure. To meet the company's requirements it is then necessary to decide on the maintenance system that provides the most satisfactory benefits overall. What training can and cannot do to reduce

Equipment Failure

Equipment failure refers to any event in which any equipment cannot accomplish its intended purpose or task. It may also mean that the equipment stopped working, is not performing as desired, or is not meeting target expectations.

Examples of equipment failure include: engine failure or misfire, brake failure or stop controlling device failure, suspension of operation due to heat or other environmental conditions, failure due to defect in the electronics or circuits, power failure or fuel supply failure, etc.

Equipment failure leads to loss of asset availability, deviation from standard procedure, not meeting the quality and expected target quantity, loss of time, labor and money, and loss of integrated system. Equipment failure can be prevented or reduced through proper maintenance management, inspection, timely finding of problems, rectification of problems, and repair.

Overall equipment effectiveness

In an ideal condition, equipment would operate 100% of the time at 100% capacity, with an output of 100% good quality.

The difference between the ideal and the actual situation is due to various losses in the process and factory. There are six types of wastes that reduce the effectiveness of the equipment and these six big losses are grouped in three major categories: downtime, speed losses and defect losses.

Downtime

Downtime refers to the time when the machine should be running, but does not. It includes two main types of loss: equipment failures, and setup and adjustments.

Equipment failures

Sudden and unexpected equipment failures, or breakdowns, are an obvious cause of loss, and an equipment failure means that the machine is not producing any output.

Setup and adjustments

Changeover of products may require some period of shutdown so that internal tools can be exchanged. The time between the end of production of the last good part and the end of production of the next good part is downtime. This downtime loss often includes substantial time spent on making adjustments until the machine gives acceptable quality on the new part.

Speed losses

A speed loss means that the equipment is running, but it is not running at its maximum designed speed. Speed losses include two main types of loss: idling and minor stoppages, and reduced speed operation.

Idling and minor stoppages

When a machine is not running smoothly and at a stable speed, it will lose speed and obstruct a smooth flow. The idling and stoppages in this case are caused not by technical failures, but by small problems. Operators can easily correct such problems when they occur, but the frequent halts can dramatically reduce the effectiveness of the equipment.

Reduced speed operation

Reduced speed operation refers to the difference between the actual operating speed and the equipment's designed capacity. The goal is to eliminate the gap between the actual capacity and the designed capacity.

Defect losses

A defect loss means that the equipment is producing products which do not fully meet the specified quality characteristics. Defect losses include two major types of loss: scrap and rework, and startup losses.

Scrap and rework

Loss occurs when products do not meet quality specifications, even if they can be reworked to correct the problem. The goal should be zero defects – to make the product right the first time.

Startup losses

Startup losses are yield losses that occur when production is not immediately stable after starting the equipment, so the first products may not meet specifications. This is a latent loss, often accepted as inevitable.

An equipment is made up of electronic components or a combination of electronic and electromechanical parts. When a component fails or a part is damaged, it leads to a failure of the equipment or system. The failure rate of an equipment may be influenced by different weighting factors, depending on the environmental and operating conditions, in which an equipment is put to use.

Environmental Stresses

Environmental stresses on equipment may be due to effect of factors which are external to the equipment such as the weather (atmospheric pressure, wind temperature, humidity, e.t.c), sea

water and so on. Any equipment which operates outdoors cannot escape the full effects of the weather in its locality.

Remedy

Most of the effects that are due to environmental conditions can be remedied by providing adequate ventilation or through forced air-cooling.

Operating Stresses

These effects may be due to the operating conditions to which an equipment is exposed. Some of the operating conditions that can cause damages to equipment are voltage surges, current surges and frequency changes. These problems can be minimized by the use of protective devices in the equipment.

OEE calculation

The OEE calculation provides information about how effectively the machine is running and which of the six big losses needs improvement. Overall equipment effectiveness is not only an indicator to assess a production system, but is also important for improvement. Overall equipment effectiveness is calculated by combining three factors that reflect these losses: the availability rate, the performance rate and the quality rate.

The availability rate is the time the equipment is really running vs the time it could have been running. Low availability rates reflect downtime losses.

Availability rate = (operating time – down time) / total possible operating time

The performance rate is the quantity produced during the running time, against the potential quantity, given the designed speed of the equipment. A low performance rate reflects speed losses.

Performance rate = total output/potential output at rated speed

The quality rate is the amount of good products vs the total amount of products produced and a low quality rate reflects defect losses.

Quality rate = good output/total output

OEE = availability rate × performance rate × quality rate.

Types of equipment failure

Types of Failure By: (Parth Gajjar (116170319007) Submitted To: Prof. G. R. KHUN), are: Yielding, Fracture, Elastic deformation, Wear, Buconcentratoin, buckling, Corrosion, Fatigue, Caustic embrittlement and Stress.

1. **Yielding:** A yield strength or yield point of a matrial is defined in engineering and materials science as the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed, some fraction of the deformation reversible. will be permanent and non-

2. **Fracture:** Under tensile stress plastic deformation is characterized by a strain hardening region and a necking region and finally, fracture (also called rupture).

3. **Elastic deformation:** This type of deformation is reversible. Once the forces are no longer applied, the object returns to its original shape. Elastomers and memory metals such as Intimal exhibit large elastic deformation ranges, as does rubber. However, elasticity is nonlinear in these materials. Normal metals, ceramics and most crystals show linear elasticity and a smaller elastic range.

4. **Wear:** In materials science wear is erosion or sideways displacement of material from its "derivative" and original position on a solid surface performed by the action of another surface. Types of Wear: Adhesive wear, Abrasive wear, Surface fatigue, Fretting wear, Erosive wear

5. **Buckling:** In practice, buckling is characterized by a sudden failure of a structural member subjected to high compressive stress where the actual compressive stress at the point of failure is less than the ultimate compressive stresses that the material is capable of withstanding. For example, during earthquakes, reinforced concrete members may experience lateral deformation of the longitudinal reinforcing bars. This mode of failure is also described as failure due to elastic instability. As shown in fig. A column under a concentric axial load exhibiting the characteristic deformation of buckling.

6. **Corrosion:** Corrosion is the gradual destruction of materials, (usually metals), by chemical reaction with its environment.

7. **Fatigue:** In materials science, fatigue is the progressive and localized structural damage that occurs when a material is subjected to cyclic loading. The nominal maximum stress

values are less than the ultimate tensile stress limit, and may be below the yield stress limit of the material.

8. **Caustic embrittlement:** Caustic embrittlement is the phenomenon in which the material of a boiler becomes brittle due to the accumulation of caustic substances.

9. **Stress concentration:** This discrepancy is explained by the presence of very small, microscopic flaws or cracks that are inherent to the material.

Operator Failure (operator error)

Operator error (or human error) is broadly defined as the cause of an unintended consequence due to a bad decision, distraction, voluntary deviation from the procedure and so on. More simply, it is “a failure of a planned action to achieve a desired outcome.” Infact, This is the inability of a person in charge of an equipment to operate it correctly so as to give the required performance. This failure can be due to the person having an inadequate knowledge of the procedures for operating such equipment. The incorrect operation of an equipment can lead to its total breakdown. Operator failure can be minimize by providing adequate training to a person in charge of an equipment. Also, no any unauthorized person should be allowed to handle an equipment. This is a period of time during which an equipment is not working. Downtime occurs in an equipment due to conditions such as those of environmental stresses, operating stresses and manufacturing defects. It may also be due to an equipment being shut down for a routine maintenance. Operator error is the subject of much research, particularly as it relates to health & safety, quality assurance, and productivity in industrial, manufacturing and construction contexts. In fact, it has been designated as the main cause of multiple disasters and accidents. Generally, it can be broken down into different categories:

Performing the task incorrectly or over the expected time allotted

Most operator tasks in a process or manufacturing plant are described in procedures. Procedures detail the sequence of steps the operator needs to perform (to clean a piece of equipment for example), indicate the risks and hazards to be expected while performing the tasks, the necessary personal protective equipment (PPE), lockout/tag out requirements and more. In this particular case, the operator is either missing the correct knowledge or know-how to perform the task correctly, and training is the primary solution.

Failing to perform or omitting a task

A failure to perform or omit task may indicate a lack of adherence to the procedure. This could be because omitting the task is de facto normalized in the plant (because it's faster, safer, easier, cheaper or any other reason). These violations are also known as shortcuts, workarounds or non-compliance, depending on which side of the task execution you are sitting. They are extremely common and are difficult to get rid of. They may require a process or procedure redesign, review of the plant culture for normalizing violations, review of safe work rules and much more. While training can play a part, it is typically not the leading fix.

Performing an extra or non-required task or tasks out of sequence

These are considered slips or lapses, or unintended actions. They are more prevalent in situations where the operator is familiar with the task and lacks concentration or focus during its execution. Training is of limited use in these cases which require improving the context of the task execution (encouraging focus and concentration) or improving the procedure/system so that slips and lapses are less probable.

Failing to respond adequately to a contingency

This is most frequently encountered when the operator faces an unexpected situation and will incorrectly apply a familiar (but ultimately incorrect) response. In other words, the incorrect task is applied while believed to be the correct one. These errors in decision-making can be attributed to a lack of experience and/or training. An interesting strategy here is to build into the training a number of plant cases (and their correct response) which the operator is not expected to encounter frequently, thereby compensating for the long floor experience required to actually witness those cases.

Making a training response irrelevant

When doing root-cause analysis, the common reflex is to stop investigating upon reaching the "operator error" stage. While this may be accurate, it is not enough to take a correct decision on what needs to be fixed, so the situation doesn't happen again. Training may or may not be a correct response, and even if it is, not all types of training will apply.

Here are five steps to ensure training is indeed relevant:

1. Perform full root-cause analysis, using the 5-whys method or other, until the ultimate root is uncovered.

2. Determine if the corrective action requires training (or a process, procedure or system redesign).
3. Determine if training applies to all operators, a specific team or individual and if training should be about reviewing the basics or providing further practice
4. Keep in mind training itself may be part of the issue and need improvements, either in content, structure or application
5. Monitor and confirm the results of the corrective training, as a continuous improvement best practice.

Malfunction

An equipment is said to be malfunctioning if it fails to work correctly. This may be due to improper operation procedure, bad alignment of the parts, partial damage to some parts or components and operational stresses. Whenever this occurs a skilled person should be consulted for advice and possible remedy. Infact, To malfunction is to fail to work properly. If your toaster spits out a charred, smoky mess no matter what setting it's on, your toaster is definitely malfunctioning.

When something functions, it works. Adding the prefix -mal (meaning "bad") to function indicates bad or unsuccessful functioning. When a computer malfunctions, you could lose your data. A malfunctioning car could cause an accident or leave you stranded. This word is typically used in reference to technology, tools, and gadgets. However, if you make a stupid mistake, you might joke that your brain has malfunctioned.

Down-Time

The term downtime is used to refer to periods when a system is unavailable. The unavailability is the proportion of a time-span that a system is unavailable or offline. This is usually a result of the system failing to function because of an unplanned event, or because of routine maintenance (a planned event).

The term is commonly applied to networks and servers. The common reasons for unplanned outages are system failures (such as a crash) or communications failures (commonly known as network outage).

The term is also commonly applied in industrial environments in relation to failures in industrial production equipment. Some facilities measure the downtime incurred during a work shift, or during a 12- or 24-hour period. Another common practice

is to identify each downtime event as having an operational, electrical or mechanical origin. The opposite of downtime is uptime. what causes downtime?

Causes of Down-Time

The common causes of downtime and how to avoid them

One of the biggest issues in any organization is when an application goes down. Downtime can lead to a bad user experience and, ultimately, cost the business money.

At a breakout session during the 2017 Google Cloud Next conference, Google's director of customer reliability engineering, Luke Stone, explained some of the top reasons for downtime and how developers and IT can fight them.

Here are some common causes of application downtime and how to avoid them.

SEE: Scheduled downtime policy (Tech Pro Research)

1. Overload

Overload, very simply, is "when demand exceeds capacity," Stone said. One way to respond is with load shedding--work to shed the excess load before it crushes the application. When at capacity, return errors before doing any work. Calculate the capacity of your service and determine what you can handle at the application server, and then serve an error to every request past that number.

2. Noisy neighbor

Users can bring spam, or another workload (backups, etc) can become a noisy neighbor. In this instance, you can't shed the load evenly, because it will unfairly affect normal users. To deal with noisy neighbors, Stone recommended putting in limits, like request limits for each user to cancel out spam bots and bad actors. You can also try to limit by IP address, but that could affect good users. So, make sure to make it configurable so you can easily help people who were wrongly affected.

3. Retry spikes

When you start rejecting users, they'll start retrying because they don't know why they were rejected. Clients can't tell the difference between a single failure and a broken service. These retry spikes can lead to a cascading failure, Stone said. To fix this, implement aggressive backoff and try to guess when the service will be overloaded so you can plan for that.

4. Bad dependency

In this issue, suddenly dependency gets really slow and requests are piling up. This problem happens when your application's input and output aren't communicating correctly. Your client must become a "defensive driver" so it doesn't overload your backend systems. You can also approach this problem with dynamic load shedding, Stone said. In the future, the organization should simulate a disaster scenario with sudden, massive load tests to figure out where the pain points will be.

5. Scaling boundaries

When an organization wants to serve more requests, they can often run into issues as they try to scale. This can cause a bottleneck between the application you're building and a service (like an API) that it is relying on. To solve the problem, Google relies on what Stone called "sharding," where a consistent workload is broken up into little chunks that can be done separately. Stone recommended sharding early and using more shards to increase capacity.

6. Uneven sharding

This occurs when one shard becomes more busy than the others, due to popularity or hot spotting, Stone said. To fix this you'll need to reshard, which can be done by splitting shards that have gotten too big, or using a shard map to determine which shards will become the most popular. If possible, leave the non-problem shards alone when you reshard, Stone recommended.

7. Pets

This is derived from the "cattle, not pets" phrase. The death of a pet is sad and hard to deal with, while the death of cattle is the cost of doing business. A "pet" is a workload or system that has too much human involvement, or is regarded as too important. Pets needs to be acknowledged and documented, so people other than the "handler" feel encouraged to work on them.

8.Bad deployment

This is the no.1 case of outages in every organization that Stone has worked in, he said. The best technique for handling outages caused by deploying bad code is having a good way to recover if you do. A tried-and-true rollback process will help, Stone said, but you must know when a deploy is happening. Also, progressive rollouts can help by being slow enough to detect problems that emerge slowly, Stone said. A good ramp up strategy is to go from 1%, to 5%, to 10%, to 50%, to 100% in stages.

9. Monitoring gaps

Many users have monitoring gaps between what the user is experiencing and what the system is telling them. Certain issues like how many errors you're serving, or your average latency can help better predict what the user is seeing. If you detect that users are unhappy, then you can further move down to checking your CPU, RAM, connection errors, and other metrics to try and determine what's wrong.

10. Failure domains

Stone described failure domains as a "chunk of your infrastructure that can fail altogether at the same time." Examples would be a VM, a certain zone, or even a certain region. To mitigate this issue, think ahead of time and try to determine which of these areas could be your failure domains and put your backups and data elsewhere. However, these domains should be used for rollouts and disaster testing so if the problem is caused by a downed zone, for example, you know it might not be an application issue.

11. Power Outages

Power outages account for 23% of downtime. For large-volume data sites, that percentage drops to 13%, but for all other sites, power outages account for 28% of downtime.

12. Usage Spikes/Surges

Usage spikes and surges account for 13% of downtime. For large-volume sites and all other sites, the percentages rise to 19% and 15%, respectively.

13. Natural Disasters or Weather Events

While frightening, natural disasters and weather events account for a very low percentage of business downtime — only 10%, in fact! That's great for all, but what about the businesses or nonprofits who believe they reside in a "safe zone," weather wise? Just like everyone else, they can't be complacent about their company's disaster recovery plan! When you look at the primary causes of downtime above, it's easy to see why no one should take data protection lightly or have the "it won't happen to us" mentality. No matter how safe you think your area is from a natural disaster, you're always going to be far more likely to lose data due to a server malfunction or by an employee.

14. Third-Party Supplier or Cloud Outages

10% of downtime can be attributed to third-party supplier or cloud outages.

15. Don't Know/Unsure

7% of downtime is caused by unknown issues.

16. Other

2% of downtime can be attributed to other causes.

Repair

Repair means responding to the breakdown of equipment and undertaking work to correct the problem in order to return the equipment to a working condition.

Before equipment can be repaired, you need to be aware that there is a problem! Therefore, there should be a clearly understood system for reporting faults and breakdowns and equipment users should be encouraged to report faults and breakdowns as soon as possible. If there is no back-up equipment, a breakdown will mean that the service the equipment was providing will come to a halt.

Overhead

Overhead (By ALICIA TUOVILA Reviewed by MARGARET JAMES Updated May 9, 2021)

What Is Overhead?

Overhead refers to the ongoing business expenses not directly attributed to creating a product or service. It is important for budgeting purposes but also for determining how much a company must charge for its products or services to make a profit. In short, overhead is any expense incurred to support the business while not being directly related to a specific product or service.

Understanding Overhead

A company must pay overhead on an ongoing basis, regardless of how much or how little the company sells. For example, a service-based business with an office has overhead expenses, such as rent, utilities, and insurance that are in addition to direct costs of providing its service.

Expenses related to overhead appear on a company's income statement, and they directly affect the overall profitability of the business. The company must account for overhead expenses to determine its net income, also referred to as the bottom line. Net income is calculated by subtracting all production-related and overhead expenses from the company's net revenue, also referred to as the top line.

Overhead expenses can be fixed, meaning they are the same amount every time, or variable, meaning they increase or decrease depending on the business's activity level. For example, a business's rent payment may be fixed, while shipping and mailing costs

may be variable. Other examples of fixed costs include depreciation on fixed assets, insurance premiums, and office personnel salaries. Overhead expenses can also be semi-variable, meaning the company incurs some portion of the expense no matter what, and the other portion depends on the level of business activity. For example, many utility costs are semi-variable with a base charge and the remainder of the charges being based on usage.

Overhead is typically a general expense, meaning it applies to the company's operations as a whole. It is commonly accumulated as a lump sum, at which point it may then be allocated to a specific project or department based on certain cost drivers. For example, using activity-based costing, a service-based business may allocate overhead expenses based on the activities completed within each department, such as printing or office supplies.

What are different types of overhead?

Broadly speaking, overhead can be organized into three main types. Fixed overhead includes expenses that are the same amount consistently over time. These can include rent and depreciation on fixed assets. Variable overhead expenses include costs which may fluctuate over time such as shipping costs. Semi-variable costs are a blend of the two. Utilities are an example of a semi-variable cost.

How is overhead calculated?

Since overhead is often considered a general expense, it is accumulated as a lump sum. This is then allocated to a specific product or service. There are a number of different ways of calculating overhead, however, the general rule is the following: $\text{Overhead rate} = \text{Indirect costs} / \text{Allocation measure}$. The indirect costs are the overhead costs, while the allocation measure would include labor hours, or direct machine costs, which is how the company measures its production.

Conclusion

“Run to fail or repair easily costs somewhere between three and 10 times as much as a good maintenance program. When the equipment does fail, the actual repair costs are exorbitant, and you typically didn't plan for them so there's a financial issue. The cost of additional labor for unplanned or reactive maintenance and repair is higher than doing routine preventive maintenance because all of a sudden, you're not in control of the resources.”

Recommendation

It is recommended that further studies be carried out on Implementing effective equipment maintenance program in industrial work place, organizations and homes.

Reference

- Homborg, A.M., et al., Time frequency methods for trend removal in electrochemical noise data. *Electrochimica Acta*, 2012. 70: p. 199-209. »
- Tinga, T., D. Soute, and H.J.H. Roeterink, *Guidelines for Condition Based Maintenance*, 2009, World Class Maintenance Consortium:
- Breda., T., Physical model-based component prognostics, in: *Maintenance Modelling and Applications*, J. Andrews, C. Bérenguer, and L. Jackson, Editors. 2011, DNV: Hovik. p. 166-184. »
- Tinga, T., Mechanism based failure analysis. Improving maintenance by understanding the failure mechanisms, 2013, Den Helder: Netherlands Defence Academy
- Adamu Goje., Maintenance and repairs of electronics equipments, Aug 13, 2018.

DEVELOPMENT OF A REMOTELY CONTROLLED CAR SPEED LIMITER ON HIGHWAY

Oni, E. O.

Department of Computer Engineering,
Villanova Polytechnic Imesi-Ile,
Osun State Nigeria
opson2k5@gmail.com,

Olawuni, A

Department of Electrical and Electronics Engineering,
Federal Polytechnic Ile-Oluji,
Ondo State Nigeria

Abstract

This study modifies a Car Speed Limiting Device based on a pre-existing design with a view to avoiding car over speeding and reduces possible accident on highway. The speed limiter was modified by incorporating a carrier chip into the device using an Arduino Nano to coordinate the activities of the carrier chip and the speed limiter. The function of the carrier chip is to send and receive notification message from owner's phone number. Two different cars were used and tested on a highway. The result obtained for the two vehicles showed the same responses. When the speed of the car exceeds the designed speed limit of the device, the speed limiter came into action and restricted the car from going beyond the pre-set speed by actuating the relay to reduce the current flowing through the fuel line and reduced the rate of flow of fuel into the combustion chamber which reduces the power output of the engine. Warning signal in the form of alarm was activated, and the receiver sent a message to the owner through the carrier chip. The study concluded that the modified speed governor design is better, safer and remotely controlled compared to the existing design.

Keywords: Car, Speed Limiter, Carrier chip, Relay, Speed.

1. Introduction

Road accidents have become something normal due to its consistent happening and ubiquitousness. Even in our present world, we believe any mechanical device could fail or show sign of misbehaviour, especially if not properly manage. Every minute someone is killed or seriously injured on the major roads because of terrible accidents (Ahmed *et al.*, 2015). A report by the International Road Federation (IRF) shows that about 2.4 million people have died in road accidents across the world with over 1.3 million road death every year and daily record of 3, 000 deaths (IRFAR, 2017). This is a worldwide pestilence practically identical to Malaria or Tuberculosis, which go after the youthful, poor people

and the defenceless (Varshith, 2016). The primary explanation behind these mischances is the fast and careless driving of motorist. The World Health Organisation raised an alarm on this figure and believes that it may increase to 1.9 million if deliberate and solid action is not taken (Tribune, 2019). Safety has become principal focus of government agencies and private organizations concerned with transportation. In Nigeria, the Federal Road Safety Commission (FRSC) is the government agency with statutory responsibilities for road safety administration. Nigeria is the most populous country in Africa with a total land area of 910,771 km² and human population of about 167 million and a high number of vehicles estimated at over 7.6 million, the country has suffered severe loss of manpower and economy to fatal car accidents (Sumaila, 2013). Undoubtedly, this population create immense pressure that contributes to the high road traffic accidents in the country (FRSC, 2017).

The factors that induce fatal car accidents in Nigeria have been classified into human, mechanical and environmental factors. Human factor accounts for up to 90% of accidents while the mechanical and environmental factors sum-up to 10 % (Assum, 2018). Human factors include visual acuteness, driver fatigue, poor knowledge of road signs and regulations, illiteracy, health problems, excessive speeding, drug abuse and over-confidence while on the steering. Mechanical factors include poor vehicle maintenance, tyre blowouts, poor lights, and broken-down vehicles on the road without adequate warning. The environmental factors are summed up into heavy rainfall, harmattan, sun reflection, heavy wind, pot holes and un-tarred roads. These factors have independently and/or collective contributed to the high prevalence rate of fatal car accidents in Nigeria (Ukoji, 2017). With the deadly crashes encountered everywhere throughout the world, vehicle safety has been set up to check them. One of the approaches to lessen such vehicle crashes is to avoid over speeding in streets and expressways. The automobile is likewise one of the primary methods for transportation, and individuals make broad utilization of it for the duration of their lives. This reason, among others, justifies the need of use of the advances in sensors, instrumentation and control in vehicles with the goal of enhancing road safety. The problem of automotive speed limiter/speed governor was considered by many investigators and researchers. Most research work concentrated on the impact of the speed limitation on the reduction of accidents and casualties (Han *et al.*, 2017). Few articles are available that concern the technical aspect of the speed limiting system. Some of the articles or publications handled the technical perspectives of the automotive speed governor system in the recent years. Croitoru *et al.*, (2014) introduced an order of speed limiting device demonstrating the advantages and disadvantages each type. He found that appropriately design ISA can be exceedingly successful in urging drivers to obey speed limits and ought to be supported by governments. Pérez *et al.*, (2018) exhibited another Infrastructure to Vehicles communication and control system for intelligent speed control, which depends on Radio Frequency Identification (RFID) technology for identification of traffic signals on the road. Their outcomes recommended that an automatic intelligent control system can be used to keep any sudden activity conditions and enhance the safety of the occupants of the vehicle.

Burje *et al.*, (2017) presented a design to control the speed of the automobiles at remote places for fixed time. Their proposed model used a microcontroller unit that gets the pedal position and after that exchanges appropriate signal to the Electronic Control Unit (ECU) that thus controls the cars' throttle position. They expressed that their theoretical study needs further extension to more than one vehicle. The objective of this work is to modify a speed governor by adding a speed notifier and SMS controller into it and evaluate a prototype of the device through experiments.

2. Types of Road Speed Limiter

2.1 Based on the Functionality (Ahmed *et al.*, 2015)

(1) Top-speed limiting

It prevents the vehicle from exceeding a set speed. Most modern vehicle engine-management systems have a top speed setting but it is usually well in-excess of maximum national speed limits and could not be regarded as a safety device.

(2) Speed alarm and speed limit set by the driver

It alerts the driver if a selected speed is exceeded. Some vehicles have this feature. It also prevents the vehicle from going beyond the pre-set speed, except for temporary over-ride situations. These are also known as "Adjustable Speed Limitation Function (ASLF)".

(3) Intelligent speed alarm and speed limiter

The system "knows" through an application like goggle map, the speed limit of the section of road and direction of travel and alerts the driver if that speed is exceeded by an audible alarm, a visual signal or a vibrating throttle pedal or a combination of these. It also prevents the vehicle from being accelerated beyond this speed.

2.2 Based on the Control Technique (Ahmed *et al.*, 2015).

(1) Throttle Control: The throttle control is a type of technique used in limiting the speed of a vehicle through throttle body of the engine. A throttle body is the intake system component in fuel-injected engines that the drivers control with the accelerator. The throttle regulates or limits the amount of air that enters the combustion chamber with the fuel delivered from the injector.

(2) Direct Fuel Control: The direct fuel control is the most type technique used to regulate the speed of a vehicle. Also, the fuel control is the most effective of all types. In this type of method, the fuel is the source of control. The speed is limited by reducing the amount of fuel that is released into the combustion chamber for combustion.

(3) Electronic Speed Governor: In this type, electric signal is utilized by using a magnetic pick up sensor. The magnetic pick up sensor is installed alongside a drive shaft gear made of material that responds to a magnetic field. As each gearing tooth passes the sensor, the gear interrupts the sensors magnetic field. This, thus, creates an Alternating Current signal, which compares to the speed of the shaft. The signal is sent to the electronic control

module to build up the measure of fuel that ought to be infused to the combustion chamber of the engine.

2.3 Basic Vehicle speed measurement System

The basic measurement system consists mainly of three blocks: Sensing element, Signal conditioning element and signal processing element. An electronic speed limiter/governor contains three key components in particular the vehicle speed sensor, Electronic Control Unit (ECU) and a fuel flow control valve. The speed sensor creates electronic pulses in relation to the vehicle speed and transmits the same to the ECU. In this examination, the sensing component converts the non-electrical signal (mechanical rotational motion) into electrical signal (voltage pulses). The reason for the signal conditioning component is to convert the variety of electrical signal into a voltage level suitable for additionally preparing. This is accomplished using amplifier circuit and digital logic circuit. The following stage is the signal condition component which is a microcontroller which takes the output of the signal conditioning component and converts it into a shape appropriate for presentation and different uses (display, recording and feedback control). Based on the installed algorithm, the electronic control unit processes the speed of the vehicle also, persistently monitors the same. At whatever point the vehicle accomplishes the most extreme set speed, the electronic control unit enacts the actuator which directs the fuel stream and henceforth the vehicle speed is constrained.

3. Methodology

Materials used are speed limiting device, relay, connecting cables, GPS antenna while tools used are cutting plier, testing lamp, razor blade and black tape

Description of Major Components

Speed Limiting Device: Speed limiter is an Electronic / Electro-Mechanical device fitted on a vehicle with the purpose of regulating the maximum speed of a vehicle to a set limit. A Speed Limiter is shown in Figure 1. The speed limiter used in this work was pre-set to 95km/h and programmed with the receiver phone number. Speed Limiters are of different types based on the vehicle category on which it is used. The two most important types are the Drive by Wire System (RDPS) and the Fuel Type System. The Fuel type system was used in this project. The speed limiter was built to have a port for the GPS antenna and the GSM antenna for receive signal. It also has another cable port for the connection of the wire that would be connected to the vehicle system.



Figure1: Speed limiter

Connection Cables: The connection cables were used to connect the speed limiter to the relay and to the vehicle. The connection cable had different cables with different colours on it, namely: blue, white, black, red, brown and yellow. The connection cables are as shown in Figure 2.



Figure2: Connection Cables

Relay: Relay is a switch that opens and closes circuit electromechanically or electronically. The relay used controls one electrical circuit by opening and closing contact in another circuit. The relay came with four (4) wires, two (2) thick green wires, a red wire and black wire. The Relay is shown in Figure 3.



Figure 3: Relay

GPS Antenna: The Global Positioning System is a worldwide radio-navigation system formed from a constellation of 24 satellites that continuously orbit the earth. All GPS receivers use an antenna to receive these signals. The GPS Antenna is shown in Figure 4.



Figure4: GPS Antenna

GSM Antenna: is an antenna to receive GSM signal to the device. It is as shown in Figure 5.



Figure 5: GSM Antenna

The specifications of cars used in this research are shown in Table 2 and 3. First thing done was to identify the fuel line cable (yellow cable with green stripes) using a Tester which is a device used to test for the flow of current in a wire or circuit. The fuel line cable was cut into two, making the wires one carrying current from the source and the other without any current in it. The divided wires were then connected to the relay. Connection of the relay to the fuel line was carried out by connecting the two thick green wires from the relay to the two ends of the fuel line cables. One of the thick green cables was connected to the fuel line cable from the power source and the other green cable to the second wire of the fuel line. The black wire from the relay to the black wire of the connection cable was joined together because the black wire is the grand wire. Both black wires were connected to any other grand in the vehicle. The red wire from the relay was connected to the brown cable from the connection cable. At the end the connection cable is plugged into the speed limiter. The red and white wire from the connection cable is connected to the thick green cable of the relay (the current source). The GPS and GSM antennas were connected to the speed limiter.

Table 2: Engine Specification (HONDA ACCORD, 2003)

Parameters	Value
Fuel tank capacity	17.1 Gal
EPA mileage estimates Highway	26 city/ 34
Base engine size	2.4 litres
Base engine type	I-4
Horsepower	160 Hp
Horsepower rpm	5,500
Torque	161 Lb.Ft
Torque rpm	4,500
Maximum Towing capacity	1,000Lbs
Drive type	Front wheel

*EPA- Environmental Protection Agency

Table 3: Engine Specification (TOYOTA COROLLA, 2019)

Parameter	Value
Fuel tank capacity	17.1 Gal
EPA mileage estimates	26 city/ 34 Highway
Base engine size	1.8 Litres
Base engine type	I-4
Horse power	132 Hp
Horsepower rpm	6,000
Torque	128Lb-Ft
Torque rpm	4,400
Maximum Towing capacity	950Lbs

*EPA- Environmental Protection Agency

4. Result and Discussion

Honda Accord and Toyota Corolla Response

Table 4 and Table 5 show the interrelation between the car speed, engine speed, speed limiter, alarm and the receiver for Honda Accord and Toyota Corolla, respectively. They basically show the response of each component as the car speed changes. The engine speed in the case of Toyota Corolla was quite different from Honda Accord due to some factors like engine capacity, vehicle weight, and material selection.

Table 4: Interrelation between car speed and components for Honda Accord

Car EngineSpeedAlarmReceiver Speed SpeedLimiter (km/h) (Rev/min)
01000On (NA)NoNo
201600On (NA)NoNo
401500On (NA)NoNo
602000On (NA)NoNo
802500On (NA)NoNo
953000On (NA)YesYes (Msg)

- NA-Not Active, Msg- Message

Table 5: Interrelation between car speed and components for Toyota Corolla

Car EngineSpeedAlarmReceiver Speed SpeedLimiter (km/h)(Rev/min)
01100On (NA)NoNo
201300On (NA)NoNo

401500	On (NA)	No	No
602100	On (NA)	No	No
802400	On (NA)	No	No
952800	On (NA)	Yes	Yes (Msg)

*NA-Not Active, Msg- Message

The two vehicles showed similar response to the speed limiter, alarm and receiver. Figure 6 shows the histogram of car speed against speed limiter for Honda Accord and Toyota Corolla.

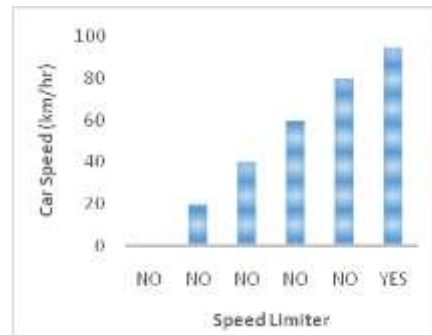


Figure 6: Histogram of Car Speed against Speed Limiter for Honda Accord and Toyota Corolla.

At 0 km/h, the engine was idle. There was no load on the engine yet. Speed limiter was on but was not active. Because the speed has not been accomplished at which it will be active. At 20 km/h, Engines of the two vehicles started running at speed higher than 0 km/h because load has been applied to it (Transmission was on drive). At 20 km/h, the speed limiter was on but was not active. Tracker was able to get signal and vehicles were able to be tracked at this speed. At 40 km/h, vehicle was moving at the constant speed while the speed limiter was not active but on. Tracker from the speed limiter was on and was able to track vehicle at that speed. At 60 km/h, no activity from the speed limiter aside the tracker been able to locate the exact location of vehicle at that point. At 80km/hr, vehicle approaches maximum speed limit and speed limiter still not responsive while it is on. At 95 km/h, Engine of each car running at higher speeds, the speed limiter became active immediately it sensed the pre-set speed, reduced the current in the flow line circuit leading to reduction in the flow rate of the fuel being supplied to the combustion chamber making the mixture a lean mixture and limits the speed of the vehicle at 95 km/h. The tracker was able to track the vehicles location as well. When trying to exceed the pre-set car speed, the car refuses to exceed the speed because of the shortage in current of the flow line.

Figure 7 shows the effect of car speed on the receiver for the two vehicles. As the speed of the car increases and approaches the maximum speed pre-set already in the speed limiter, the receiver responded variably. At 0 km/h when the vehicle is idle, the receiver

is on but not responsive at 0 km/hr. At 20 km/h, the engine was under load and vehicle was moving and yet the receiver is still not responded. At 40 km/h, the vehicle was still being driven and no output from the receiver from the speed limiter. At 60 km/h, receiver was on but no output from it. At 80 km/h, the vehicle was approaching the maximum speed limit and receiver was yet to respond to the speed at which the vehicle was been driven at. At 95 km/h, receiver is fully functional and responsive. The speed limiter stored the data to its history and when the network was restored, the speed limiter sent the message through the carrier component to the owner's phone as a text message as shown in Figure 8 and at that time the message was seen from the owner's phone. The vehicle was shut down by sending a code "<SABO*STP>" and a confirmation message saying "lock car successful" was received as shown in Figure 9, then vehicle shut down immediately. The vehicle started again as the owner restores the vehicle by sending "<SABO*RES>" and the owner (person sending the message receives a message too saying "unlocked successfully" as shown in Figure 10, then the vehicle will start again.

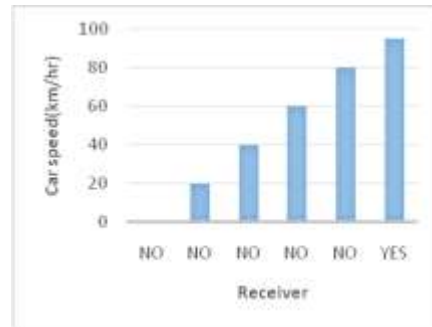


Figure 7: Histogram of Car Speed against Receiver for Honda Accord and Toyota Corolla.

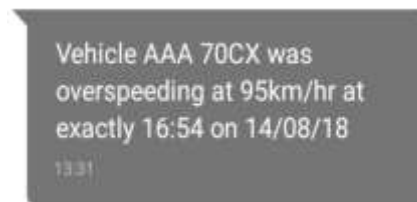


Figure 8: Message from the Receiver

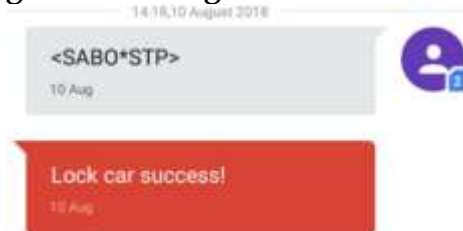


Figure 9: Message from the Speed Limiter after Sending the STOP Code



Figure 10: Message gotten after sending restore code

Figure 11 shows the response of the alarm at different car speed for the two vehicles. The alarm is the sound notifier that alerts the driver when the vehicle approaches or reaches the maximum pre-set speed on the speed limiter. At 0 km/h, car was on and running but alarm wasn't ringing. At 20 km/h, vehicle was moving and alarm wasn't responsive. At 40 km/h, still running the car and the speed limiter was still not responsive. At 60 km/h, vehicle was still working and running but the alarm was not working. At 80 km/h, vehicle approached maximum speed and the alarm was yet to respond. The alarm started working when speed exceeded 80 km/h and above. The sound became more pronounced when the speed got closer to the maximum speed. At 95 km/h, the car was at its maximum speed and the alarm was beeping continuously till the speed drops below the pre-set speed. When the speed drops below the maximum speed, the alarm reduced gradually. Between the speeds of 0-80 km/h, the alarm is inactive.

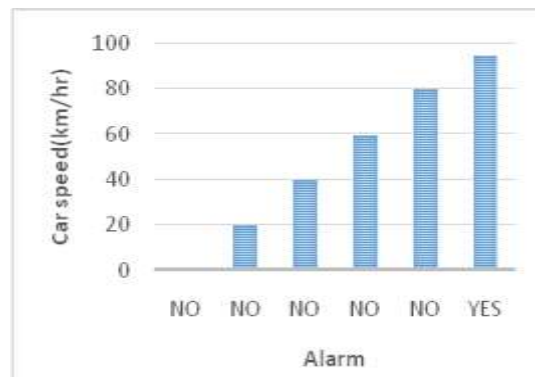


Figure 11: Histogram of car speed against alarm for Honda Accord and Toyota Corolla

5. Conclusion

This project has improved an existing speed limiting system by adding a notifier and SMS controller. The prototype programmed to limit speed at Federal Road Safety maximum speed at highway to be 95 km/h was able to limit vehicle speed at its maximum speed (95 km/h). The transmitted alarm sounds when the vehicle approaches 95 km/hr and the receiver also gives or sends a text message when the car gets to its maximum speed, alerting the owner the speed activity of the vehicle. The relay, showed that once the speed

drops below 95 km/h the engine picks up again. The improvement basically provided an economic solution to deadly car crashes, save vehicle fuel consumption and also monitors the activities of the driver. The project was focused more on limiting the speed of the vehicle and informing the owner about vehicle over-speeding activities. The project can further be improved by considering the system with google map road speed limits to know areas with their speed limits.

6. Reference

- [1] Ahmed, F. A. and Talal S. M.(2015),Proposed simple electro-mechanical automotive speed control system, American Journal of Aerospace Engineering, Special Issue: Hands-on Learning Technique for Multidisciplinary Engineering Education, 2, 1-10.
- [2] Assum, T. (2018), Road safety in Africa: An appraisal of road safety initiatives in five African countries, In The World Bank and United Nations Economics Commission for Africa, 33(2), THE GLOBAL IMPACT, 67.
- [3] Burje, S. R., Kulkarni, S. A. and Dhande, N. B. (2017), Design and development of microcontroller based electronic speed governor for Genset /Automotive Engine, International Journal of Engineering and Science, vol. 1, pp. 26-33.
- [4] Croitoru, B., Tulbure, A. and Abrudean, M.(2014),Microcontroller- based multiple platform PWM signal generation procedures for industrial use. Automation, Quality and Testing, Robotics, 2014 IEEE International Conference.
- [5] Federal Road Safety Commission (FRSC), (2017), Research Monogram, No. 2, Road Mirror.
- [6] Fleming, W. J. (2017), Overview of automotive sensors, IEEE sensors journal, vol. 1(4), pp. 296-308.
- [7] Han, M., Liang, D. F. and Deng, J.(2017),Sensor development using its unusual properties of Fe/co copper based amorphous soft magnetic wire. Journal of Materials Science, 40(21), pp. 5573-5580.
- [8] International Road Federation Annual Report (IRFAR) on the state of accidents in the world, (2017).
- [9] Nigeria Highway Code, 2015-2019.
- [10] Ogasawara, I. and Ueno, S.(2018), Preparation and properties of amorphous wires, IEEE Transactions on magnetics, 31(2), pp. 1219-1223.
- [11] Sumaila, A. F. (2013), Road crashes trends and safety management in Nigeria, Department of Transport Management Technology, Federal University of Technology, Minna.
- [12] Tribune - Road Safety Nigeria. March 13th, 2019.
- [13] Ukoji, V. N. (2017), Trends and patterns of road accidents in Nigeria: (June 2006 – May 2014). Online Article. www.nsrp-nigeria.org.
- [14] Varshith, H., and Navale, D. J. (2016), Automobile speed limiter and reliever for automobiles, PES Institute of Technology and Management, Shivamogga, Project No.:37S1003.