

# GLOBALIZATION IN THE CONTEMPORARY WORLD ORDER AND ITS IMPLICATIONS ON AFRICAN SECURITY AND ECONOMY

Ambrose Abaneme  
Department of Political Science,  
Alvan Ikoku University of Education  
Owerri

Samuel Nwagbo  
Department of Political Science,  
Nnamdi Azikiwe University Awka,  
Anambra State.  
[Snc.nwagbo@unizik.edu.ng](mailto:Snc.nwagbo@unizik.edu.ng)  
. 08032744044

## Abstract

*Globalization, understood in terms of a perfectly integrated global market, a global society, global civilization, interdependence, internationalization, universalization or liberalization process has no single fixed or determinate historical context, in all the historical stages of globalization processes: the age of discovering or classical globalization (1450 – 1850); the second wave that evidenced a major expansion of European empires (1850 – 1945) ; the period of emergence of American dominance and ideology of liberalism (1945-1960), and the present system that marked the intensification and triumph of American led capitalist values – liberalism and democracy (1960-present); the common feature inherent in them is that the South, particularly Africa has continued to be at the receiving end. This work attempts to examine the security threats of contemporary globalization to Africa. The study contends that, globalization, which is led by a new age of information technology, may rather pose much security threats to Africa than significant gains, considering the vulnerable institutional and socio economic systems of African societies or social formations.*

**Keywords:** Globalization, interdependence, security threat, liberalism, African societies

## INTRODUCTION

National security is a key factor in those national interests which leaders and policy makers hardly compromise. Assessing the security capabilities of nations, Morgenthau (1960) opines that "a nation is secured to the extent to which it is not in danger of having to sacrifice core values if it wishes to avoid war, and is able if challenged to maintain them by victory in such a war.

However, in this world of interdependence, the nature and definitions of security had also been changing by a growing process of inter-dependency between nations. The security of each individual nation is currently influenced and shaped by socio-political structures and actual national experiences. The summation of these conditions helps to determine the sources of threat to a country and the evolution of its security concept and strategy.

For us, security is seen beyond traditional maintenance of military strength to ward off aggression against the state, or the expansion of apparatus of internal security to ensure domestic order. The security of a nation traverses through the complex web of political, economic, social and cultural structures, and links with the whole range of inter-state relations.

Viewed in the broader context of the security of nations, the African continent is most vulnerable in the present world of globalization and is therefore confronted by a number of security threats.

This paper therefore examines the security threats engendered by contemporary globalization in four thematic sections. Section two after this introduction deals with the theoretical framework, conceptualization and some clarifications on globalization. Section three attempts a consummated discourse on the security threats of the current globalization to Africa. Finally, section four concludes by providing the critical implications and suggestions on the way forward for African societies and social formations.

## THEORETICAL FRAMEWORK

This study adopted Dependency Theory as theoretical framework. This theory was propounded by Andre Frank and championed by other scholars like Galtung, Dos Santos, Sauvy Alfred, Baran, Rodney, Claude Ake, Aja etc. The theory examines the effect of the relationship that exists between the developed and the newly independent (developing) states. It is a Marxist concept that describes the extent to which one economy is subordinated to the other and in which case, the internal dynamics of one is conditioned by external stimuli. Dependency means that crucial economic decisions are not made by countries that are being developed but by foreigners whose interests are carefully safeguarded. It describes the extent to which an economy is structurally disadvantaged in the international division of labour. That means, it lacks autonomous capacity to exploit, control and manage its natural, economic and human resources without falling prey to the dictates of foreign economies and other external interests (Aja, 1998:48, Nwagbo, 2012:51). The theory maintains that wealth and poverty of nations result from the global process of exploitation. Thus an

economy is dependent when its position and relation to other economies in the international system and the articulation of its internal structure make it incapable of autocentric development (Ake, 1981:55). This is exemplified in the study at stake where globalization and contemporary world order have marginalized and underdeveloped African economies. And the economy of the North which claims to develop Africa (South) is getting developed. It will help us to appreciate the effects of globalization in the underdevelopment of third world countries.

## **GLOBALIZATION: CONCEPTUALIZATION AND SOME CLARIFICATIONS**

Globalization as a social concept is a multidimensional phenomenon. It therefore has attracted various definitions or conceptions in different times and contexts. The perspectives of scholars differ fundamentally based on their ideological standing. These divergent views however have been conceived from two contrasting paradigms such as globalization as interdependence and globalization as imperialism, as viewed by two broad schools of thought: the liberal and the Marxist, respectively.

### **THE LIBERAL VIEWS**

The liberal scholars who are predominantly western and pro Euro-centric scholars perceive globalization as a framework of complex and growing interdependence among nations. The global socio-political and economic interpretation is viewed in the context of inter-dependencies which has restructured the world into a new and all inclusive social pattern. They associate globalization with economic liberalization as a policy option for the development of the South through a process of free trade, investment and capital flows between countries (Danja 2012: 13). Danja further stresses that the liberal scholars, have consistently maintained that globalization is the rational and point of human development and that it is capable of impacting positively on the lives of state actors that integrate their economies. On this background, David Held, Anthony McGrew, David Goldblatt and Jonathan Perraton assert that globalization may be thought of initially as a historical promise, the widening, deepening and speeding up of worldwide interconnectedness in all aspects of contemporary economic and social life from the cultural to the criminal, the financial to the spiritual.

In this respect, globalization reflects a wide spread perception that the world is rapidly being molded into a shared social space by economic and technological forces and, development in one region of the world can have profound consequences for the life chances of individuals or communication on the other side of the globe.

In line with this view, Gidden (1990:21) defines globalization as the intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice-versa.

In another dimension, Scholte (2000:46) and Harvey (1999) view globalization from its impact on national border. To Scholte, globalization is de-territorialization of the growth of supra territorial relations between people, while Harvey equally refers it to time space compression. To this therefore, globalization embodies a process of deterritorialization. As social, political and economic activities are increasingly stretched across the globe, they become in a significant sense no longer organized solely according to strictly territorial logic hence, Scholte (2000) further opines that the phenomenon constitutes a transformation in the spatial organization of social relations and transactions. Although geography and distance still matter, globalization is synonymous with a process of time-space compression – literally a shrinking world – in which the sources of even very local developments from unemployment to ethnic conflict may be traced to distant condition or decision (McGrew, 2014).

The crux of this definition is that globalization is seen to mean decoupling of space and time, emphasizing that with international communication, knowledge and culture can be shared around the world simultaneously (Weng, 2006).

The highlight of these definitions is that globalization is a process that is multidimensional which involves much more than simply growing connections or inter-dependence between states. In this vein, McGrew Anthony opines that:

*Globalization is a historical process involving a fundamental shift or transformation in the spatial scale of human social organization that links distant communication and expands the reach of power relations across regions and continents (2014)*

The import of this definition lies on its emphasis on the distinction of globalization from internationalization. To this therefore, he stresses further that whereas internationalization refers to growing interdependence between states, the very idea of internationalization presumes that they remain discrete national units with clearly demarcated borders. By contrast, globalization refers to a process in which the very distinction between the domestic and the external breaks down. Distance and time are collapsed, so that events many thousands of miles away can come to have almost immediate local consequences while the impacts of even more localized developments may be diffused rapidly on the globe. This is not to argue that distance and borders are now irrelevant. It is rather to acknowledge that, under conditions of globalization, their relative significance, as limits upon the exercise of power, is quite so strong as it may have been in the past. On distinction with regionalization, he points out that if globalization refers to transcontinental or trans-regional networks, flows, or interconnectedness, then regionalization can be connectedness and integration among states which share common borders or are geographically proximate as in the European union or ECOWAS (McGrew: 22).

Conclusively, the liberal scholars who are the proponents of globalization as inter-dependency therefore believe that the global arena would be better if nation states would realize and utilize to the maximum the opportunities presented by the interplay resulting from globalization. Their belief is hinged on the premise that interdependency has opened up the world, reduced the abuse

of human rights, and eradicated, to a large extent social and economic injustices by national government (Danja, 2012:14). However, the negligence of the problems and challenges of globalization and its implications on the unequal distribution of whatever gains that accrue to the world by globalization, motivated the critique school to offer alternative perceptions of the phenomenon.

## THE RADICAL OR MARXIST VIEWS

In contrast to the liberal view, the radical scholars' perceived globalization from its effects particularly to the less developed world and declare that globalization is another form of capitalist imperialism. Some of the notable advocates of this school of thought include: Claude Ake, Okwudiba Nnoli, Ali Mazuri, Nabudere and Felix Oriakhi, etc. In his contribution, Nnoli (2003:173) argues that "this new system of globalization has aided the growth of liberal democracy in Africa and elsewhere in the world. With the end of the cold war, liberal democracy seems triumphant. The task of globalization is to universalize it . . . It diminishes the relevance of the nation states in human affairs. The result is political disorientation and popular disempowerment"

Chastising further the liberal views of interdependence, Ake (1992) observed that the new order is the radical division of the world into rich and poor nations, aggregations usually referred to in geopolitical terms as North and South. It is characterized by gross inequality which is destabilizing on account of its association with extreme poverty. Moreover, the end of ideology which is always acclaimed as an asset to peace will accentuate the bitterness of contestation. He further sees globalization as a capitalist project that is structured to perpetuate the underdevelopment of Africa and other third world countries hence he asserts that:

*Globalization is about growing structural differentiation and functional integration in world economy; it is about growing interdependence across the globe; it is about the nation-state coming from under pressure from the surge of transnational phenomenon, about the emergence of a global mass culture driven by mass advertising and technical advances in mass communication (Ake 1995 in Danja 2012:14)*

Though Ake recognizes the interdependence essence of globalization, the crux of his definition is on who gains and losses in this interconnectedness.

Alongside this view, Nabudere (2000) avers that globalization is a capitalist economic project that is propelled by two contradictory movements –first, the tendency of economic globalization to create uniformities in the entire world – and second the tendency of marginalization and fragmentation, which the phenomenon connotes . . . these two processes make it possible for globalization to spread out its risks and losses throughout the global arena. The implication of capitalist and imperialist context of globalization was given by Oriakhi (2001: 24), who posited that globalization superimposes the values of the North on the South by accelerating the successful penetration of capitalism and other bourgeoisie ethos into the nooks and crannies of Asia, Latin America and Africa and the erstwhile non-capitalist states of Eastern Europe

In all, the radical scholars were interested not on verbal and definitional conception of globalization but whose interest globalization is meant to serve. The central theme of their argument is that globalization, like any other form of capitalist and imperialist socio-economic phenomenon, is exploitative and for the perpetuation of the third world dependence and under development.

## **THE SECURITY THREATS OF GLOBALASTION TO AFRICA: PSYCHOLOGICAL AND ATTITUDINAL THREAT**

One of the major threats of the new world order is the open contempt and presumption that African interests do not matter any longer. This was propelled by Marguerite Michael's statement that "the United States has been retreating from Job's (African) continent since the implosion of the Soviet Union set America free to pursue its own interests in Africa and it found it did not have any". As a follow up to this statement, the London Economist equally reported that "with Cold War interests gone, it is tempting to forget Africa. Eastern Europe and still useful recession in the rich world makes generosity harder. Besides, aid to black Africa has a depressing record". The most shocking revelation of the North's inflammatory attitude envisaged in this era, was clearly given long ago by Hugh - Trevor Regius as cited in Ake 1992. Thus;

Africa for now has no history; perhaps they may have history in the future. Presently, what we have is the history of Europeans in Africa. The rest is darkness and darkness is not a subject of history.

Similarly, Henry Kissinger was quoted as saying that "nothing has ever been produced in the South; the axis of history starts from Moscow to Bonn, across to Washington and then finally to Tokyo. (1988:31-32). Therefore, what happens in the South (Africa included) is of no importance to the North.

The above utterances have elicited the North's unquestionable double standard towards Africa. It also exposed the North's regard for and treatment of Africa with contempt; it has strengthened the North's rapacious and unabashed exploitation of the African economies without restraint, since they feel that Africa has no history (origin) and relevance; Africa, for them, should be subordinated, and made dependent to their commandments and coercion.

Even the American secretary of State who visited Africa in October, 1999 acknowledged publicly the American wrong impression of Africa by declaring that, the Clinton administration sees Africa partly as a source of trouble, such as drugs, terrorism, diseases, violent conflict and international crime, and partly as a business opportunity for US companies.

The consequential effect of this fear of negligence is that Africans would individually be clamouring for the North's favours, which would equally have detrimental impact on the continental cohesion, solidarity and unity. This therefore leads to the next threat.

## **SATELIZATION OF AFRICA BY THE NORTH**

The satelization of Africa by the wealthier nations of the North is another source of division and conflict in Africa. This leads to many proxy wars fought in Africa. Most countries in Africa are plural societies, prone to violent, atavistic nationalism, territorial disputes, and struggle over natural resources. This is as a result of rapacious exploitations, ill-defined and arbitrary colonial boundaries, arbitrary unification of hitherto distinct nationalities with diverse cultures, languages, religions, and each of these nationalities lives in its own land mass. They were not just merged forcefully by these colonial masters of the west, but their differences were deferred by divide and rule methods of administration. This differing – differences existing, especially, in Africa, cause a lot of internal and external conflicts in the continent at one time or the other.

Also, globalization would equally intensify divide and rule politics at the continental level in Africa. While Africa is continuously and systematically satelized, the North has become more conscious and more solitary as exemplified by G-7 keen defenses of their collective, interests, especially when it comes to the North-South issues. Also, the stronger unity of the European Union is even a threat not only to Africa but somehow to the United States. The unity in the North against the South transcends the Northern academic theories of the world order earlier stressed. This contradiction therefore is a true revelation of the North's agenda.

In addition, the end of ideology [East-west conflict] which has been associated with peace and stability had bred more bitterness, particularly in Africa, because as "the bond principle and political morality is let loose and yield to pragmatism, the struggling national entities, absorbed in their self-aggrandizement, confront manner. More so, the end of ideology approximates the end of innocence, it democratizes international and inter-regional politics, transforming it into a Hobbesian struggle – not that there is no order of hierarchy, but there is the structuring of order, hierarchy, state and functions of more power; thus, the world becomes nastier in the new dispensation with great detrimental effect on Africa.

## **THE LOSS OF TRADE CONCESSION AND ITS EFFECTS**

In World War II era, following UNCTAD I, and the adoption of part IV of the GATT, developing countries (particularly those of Africa) were allowed to use import controls to protect their infant industries. The IMF equally allowed them to use exchange controls to promote their balance of payments. But the Uruguay Round has abolished all these differential treatments and trade concessions. Consequently, African weak economies are now exposed to competition without any form of control with the highly sophisticated industrialized firms. The implication is that systematically, African indigenous entrepreneurs would gradually go into extinction, and dependence on foreign multinational goods and services would be instituted absolutely. Unemployment would therefore hasten beyond reasonable control.

The plight of Nigeria pilots is a case at hand. The indigenous group under the name of Association of Unemployed Pilots in Nigeria cried out recently that "there are over 300 qualified pilots in Nigeria who are jobless". The Federal government has closed its eyes as if there is no law protecting its pilots against unemployment. It is only in Nigeria (a typical case for Africa) that indigenous employees are laid off for foreigners; not in Yugoslavia, Russia, or Europe, can this happen!

## **ECONOMIC PLIGHT OF AFRICAN SOCIETIES IN THE ORDER**

Indeed, economic threats have been a major security threat to Africa under globalization; because economic weakness engenders other weaknesses: military, political, and technological. Economically, the post Cold-War era could be defined essentially as the triumph of neoclassical of the dominant on a global scale and the possible constitution of the dominant economic powers in to three major economic blocs.

This triumph implies that the major political and economic imperative for Africa is compulsory acceptance of the free market ideology. The effect of this is already being felt on the rather harsh system of economic management being imposed on the African states through the instrumentality of the IMF and World Bank, and closely co-ordinated by the Western Countries. More so, the management of debt is central to the regime of SAP and underlies the reverse flow of resources from Africa to the advanced capitalist countries. The undesirable flow of resources out of Africa in the emerging globalization process is the real security issue for Africa, as there seems to be lack of will to reduce poverty, epidemics and hunger on the continent.

The gap between the North and South rather than narrow is widening more and more. The North has consistently been an extractor of capital from the South. The net flow of \$2-5 billion from the World Bank in 1983 turned into a negative flow of \$350 million by 1987; during the same period, net payment from developing countries to the IMF increased to \$2.7 billion; meanwhile, new lending to developing countries has slowed to a trickle as the overall flow of capital flight from the South reached \$43 billion in 1988 (Ake, 1992).

Igwe (2011:103) properly exposed how globalization controlled by the US-led G7, locked Africa, and the rest of the other LDCs in underdevelopment through a relationship of dependency from the west. He argues that the establishment of Bretton Wood' institutions at the end of World War II resulted in an unprecedented degree of global economic and societal integration. The great expansion of world trade and production in the 1950s and 1960s resulted in a global intensification of competitive pressures on businesses and governments in the 1970s. Initially, this growing competition affected negatively more core economies and the U.S than the peripheral economics, but later the effects was more on the LDCs.

The African Economy and welfare according to Igwe (2011:105-106) rose in both the 1960s and 1970s whether assessed by GNP per capita or by the more inclusive index HDI. Africa's GNP per capita rose by around two-fifth from 1960

and 1980. South Asian's GNP per capita in the 1980 was more than one third of the GNP per capita in 1960. After 1980, the situation radically changed. In 1980 the per capita incomes fell in Africa and rose in South Asia by half. This is demonstrated in the table below:

Table 1: *GNP Per Capita for Regions as percentage of 1<sup>st</sup> World's GNP per capita*

<b>Regions</b>	<b>1960</b>	<b>1970</b>	<b>1980</b>	<b>1990</b>	<b>2000</b>
S. Sahara Africa	5.2	4.4	3.6	2.5	2.0
Latin America	19.7	16.4	17.6	12.3	13.7
West Asia & North Africa	8.7	7.8	8.7	7.4	8.3
South Asia	1.6	1.4	1.2	1.3	1.6
East Asia	5.7	5.7	7.5	10.4	10.0
China	0.9	0.7	0.8	1.3	3.0
3 <sup>rd</sup> World	4.5	3.9	4.3	4.0	4.5
North America	123.5	104.8	100.4	98.0	121.1
Western Europe	110.9	104.4	104.4	100.2	85.8
Southern Europe	51.9	58.2	60.0	58.7	56.2
Australia and N. Zealand	94.6	83.3	74.5	66.2	65.9
Japan	78.6	126.1	133.1	149.4	135.9
1 <sup>st</sup> World	100	100	100	100	100

Source: (Arrighi, 2007 in Igwe 2011)

In the effort to unravel the mystery behind Africa's economic decline in the era of current globalization (1980-present), Arrighi (2007:195) argues that, the United State's sudden change of policy in the early 1980s, from promoting the "development project" of the late 1940s and early 1950s, to promoting neo-liberal globalization is possibly one of the main causes of economic stagnation in Africa. He further argues that structural globalization has increased economic growth in East Asia during the 1990s, but that ideological globalization in contrast, has increased income inequalities and perpetuated uneven development throughout the world, especially in Sub-Saharan Africa. In fact, the increase in economic growth in South East Asia in the late 1980s and 1990s could be linked to the increase in US demand for cheap industrial products. The redirection of capital flows towards the United States helped to improve the Asian balance of payments and lessened their need to compete with the United States in world financial markets and even turned China into a major lender to the US. Africa in contrast, retrogresses economically because it did not manage to compete as favourable for a share of the US imports of agricultural product in 1980s.

The crushing external debt burden on African countries compounded the problem. Whereas in the 1970s, Africa's external debt stood at a mere \$48.5 billion, the figure is now well over \$300 billion; worse still, since 1992, Africa's exports and imports as a share of total trade has declined from 4% to about 2%. And perhaps, worse of all, it has recently been pointed out that in 37 percent of Africa, private wealth is held outside, whereas for Asia the share is 4% and for Latin America, it is 17%. The effect of this is perpetual poverty of the masses.

Also, resources flow from the North to Africa, especially developing assistance, which were largely driven by the necessities of the Cold War. Now that the Cold War is over, partnership in development which was geared to winning and

keeping allies in the South's (Africa) demand for development assistance has been tiresomely unrelenting. The North worries again that its assistance is quite unhelpful to the South (Africa), since so much of it is usually mismanaged or corruptly appropriated. Some have suggested that the North is suffering from "Compassion fatigue" (Abaneme and Ndubuisi, 2012).

The above is true because apart from external threats to the South, the ruling classes and their comprador or petty bourgeois allies have been engaged in mismanaging and corruptly misappropriating the borrowed or national wealth in their respective economies. Hence, they have constituted internal threats. Rather than being instrumental to the development of these economies, most African bourgeoisie are parasitic to their economies. A typical example of the above is the Nigerian dominant class, which lacks the kind of discipline and nationalism which enabled its counterparts in South Korea, or Brazil to embark on some "acquisition and development of technology". While these counterparts were able to derive some benefits for their countries through some form of alliance with foreign capital, the Nigerian bourgeoisie has been content to play a second fiddle to foreign capital.

The Nigerian dominant class is incorrigibly corrupt. This has gone down deep into the fabrics of both the private and public sectors. This unpatriotic act perpetuates imperialism and dependency since most of the public policies are meant to serve the single interest of both the African dominant classes and their foreign counterparts. More so, the use of state apparatuses for private accumulation by the bourgeois groups means that whether or not they control state, all factions of the bourgeoisie place a "high premium" on it, and the struggle for access to, or control of it, "becomes exceptionally intense and tangentially normless".

Thus, this engenders instability, repression of popular political groups and alienation of the Africa population. As a result, coups and counter-coups, civil wars, insurrection, secessionist movements, policy instability, underdevelopment and impoverishment of the majority of the populace, starvation, ethnic clashes, refugee problems, illiteracy, etc., are perpetuated on the African continent as has been demonstrated in Nigeria (in the military era), Liberia, Somalia, Angola, Rwanda, Sudan, Sierra Leone, Guinea Bissau, etc.

## **EROSION OF AFRICAN NATIONAL SOVEREIGNTY**

The actual application of globalization would mean that national sovereignty has actually lost its classical definition and practice. The so-called absolute independence of nation-states in terms of territory and foreign policy option, even in internal policies could only find anchorage in theory. Practically, with the emergence of this order, globally, sovereignty has changed in both meaning and practice. The erosion of national sovereignty was pragmatically demonstrated and consolidated during and after the Gulf war. Brzezinski has echoed that in trying to curb the danger of threats from the South, the international community may have to be guided less by the seemingly internal affairs of the state as in Yugoslavia yesterday and perhaps elsewhere (invariably Africa) tomorrow may be necessary and justified.

Again, this unguided integration would give the multinational corporations undue advantages as they would grow in power under the current liberalization of the Third world environment to impose policy decisions that negatively impact on the economic sovereignty of the sub-Saharan African countries for their selfish interests.

## **THREAT TO POLITICAL STABILITY: EFFECT OF IMPOSED WESTERN DEMOCRACY**

Evidently, globalization is not a new mode of production. As a new mode of operation, it is only an expansion of the existing mode of capitalist production. As we have demonstrated, there is nothing new, presently, except technological revolution, which is of global historic and strategic importance. But, it has a hidden agenda in the sphere of ideology and politics.

Contrary to the expectations therefore, the post-Cold War era has not turned out to be a source of political stability in Africa. The eclipse of the ideological struggles has simply channeled destructive energies in other directions. It has initiated upheavals accompanying demands for democratic empowerment of the populace, unleashed ethnic hatreds and social division and inspired the resurgence of micro-nationalism as a force of virulent antagonism. Political turmoil has become a common feature of African continent. There is political crisis in Algeria, Somalia, Angola; Secessionist bids in Kenya, Ghana and elsewhere. In Nigeria's democratic process, the growing factionalism and ethnic sentiments have not given stability a chance. The security predicaments of this political crisis and instability could be attributed to the tasking and expensive process in aping western democratization processes. The political impact of the global pressure for liberalization of weak economic bases is the major cause of Nigeria's and other African countries' problems.

Acknowledging the burden of this pressure, former Nigerian President, Obasanjo lamented that, Nigeria would become or remain secure and stable, though a subservient member of the global village, but requested that the international community which had invested so much in returning Nigeria to democracy should not allow the investment to fail – which will ultimately happen if the debt burden on African Nations, including Nigeria, is not radically reduced (Guardian, 2014)

## **SECURITY THREAT AND TECHNOLOGICAL REVOLUTION IN AFRICAN SOCIETIES**

The so-called revolution in telecommunication and information technology is another change with a detrimental impact on Africa. The New World Information and Communication Order which is aimed at the centralization of access to global information and a balance in the flow of information from developed countries to LDCs would exploit Africa.

In fact such project is repressive and capable of perpetuating economic servitude of Africa because global information is controlled by five giant organs of the North, namely, AP, AFP, UPI, Reuters, and TASS; while Africa controls less than 1%. With this 99% of domination, the DCs have exercised dissemination, in respect of all the newspapers and radio and television stations worldwide. Obviously, since whoever controls information controls economic and political power, a new information/communication order is imperative, otherwise Africa would be written off.

## **SOCIAL AND POLICY IMPLICATIONS AND THREATS**

Globalization presumes to constrain social and public policy by its implicit assumption that these policies should follow the needs of international capital rather than change the economic environment by modifying the behaviour of economic agents and actors, since the transnational corporations are not only self-interested entities run by self-centered corporate individuals. Public policies which enhance social solidarity, equality, fairness and justice become discounted, even within the national environment. The consequence if more crises and conflicts like the case of the Niger Delta in Nigeria.

Also, the social peril of the new order is better appreciated in Bountrous Bountrous-Ghali's alarm during one of the UNCTAD opening address held in South Africa, thus:

*The fate of the needy two billion unemployed people on earth hangs in the balance. Globalization can create greater marginalization of the poor, more social insecurity and inequalities and disequilibrium among countries*

So, African economies and social setting have been completely dis-articulated and disjointed, respectively, by the New World Order controlled by the forces of globalization.

Finally, the aculturalization of Africa in this era has detrimental implication for development. The Chinese success in economic growth is not unconnected with its cultural preservation. The Americanization of Africa would ensure a preference for western goods and services. Domestic goods are abhorred; indigenous development therefore would be totally discouraged.

A nation's cohesion could easily be destroyed through breaking their culture and religious beliefs. As Chinua Achebe echoed, the success of colonial entry into the African territory was through the destruction of traditional religion and other African cultures. America has scientifically started it again through cultural globalization: The US Free Visa Lottery, for example!

## CONCLUSION

From the foregoing, we can perceive that the security threats of the "New World Order" is and would be negatively enormous to Africa if the global status quo is maintained. If the present posture of the North against Africa is maintained, Africa, where the process of economic integration is yet in an embryonic stage, would be greatly exploited by the North.

As Europe is becoming a "fortress", and America is becoming more ambitious, confrontational and even more coercive to the South and Africa in particular, one would envisage more economic, political and social problems which would threaten Africa's already precarious security as long as there exists unpatriotic and institutionalized corrupt regimes and centrifugal forces in Africa; ethnic killings, insurrections, violent protests, and their consequent instability and economic down turn and disarticulation of African Intra-national co-operation.

As long as extreme wealth and extreme poverty prevail in the world system tension and hostility would persist between the North and South (Africa), as huge scarce resources that would have been channeled to development would be diverted to stopping wars, in the name of peace keeping, peace enforcement, resettlement, maintenance of refugees in the poorer countries.

African countries should therefore put their colonial experiences behind them, damn the imperialistic theories of the West, and make use of the available technology, abundant natural and mineral resources to develop their economies and become self reliant; for it is when a country is self reliant that it can compete or liberalize its system with the outside world. For this to happen, African leaders and policy makers must borrow a leaf from the newly industrializing countries of South East Asia, South Korea, Indonesia, China etc., some Latin American countries like Brazil, who through nationalism, patriotism and discipline, their leaders and bourgeoisie were able to adapt the existing foreign technology to their own "technological capability" and launch their countries into development courses.

Again, African countries should be able to outlive their colonial heritage of divide and rule, and settle their internal disputes through dialogue, persuasion, confidence-building and cooperation in place of war, and violence. Having known that war, especially in the Third World is economically wasteful, they should behave like the "Hobbesian" man in civil society, who having realized that violence is bad had to reach a consensus to stop violence. To that effect, accountability and transparency should be the guiding principles of the leaders and public servants.

More importantly, African Nations should intensify their intra-national trade and other co-operation, for it would make them stronger, just as Europeans and America, despite their differences, always forge a common front as expressed in the EU, OECD, NAFTA, NATO, G-7; particularly, when dealing with the south. Consequently, there is urgent need to diversify their export goods and services. Efforts should be channeled toward manufactured and processed export goods and services.

Finally, the hope and strength of Africa lies more in the revival of a strong non-aligned movement, UNCTAD, South-South cooperation and a vigorous pursuit of its aims and objectives, so as to match words with actions in their negotiations with the North.

Efforts should equally be made in mounting tireless pressure for restructuring the United Nations towards the inclusion of Africa into the veto power arm of the Security Council.

Indeed for the whole world, democratization of the world system – the UNO, collective decision and dialogue, narrowing of the wide gap between the rich and poor nations, would enhance enduring peace and stability, not the use of coercion to enforce peace.

Therefore, if the contemporary globalization is to be an improvement on the old; if it is to have change at all in terms of realizing peace and security, it must have a global human face; stand on a concerted pursuit of true democracy and even development for all nations and peoples.

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# ON THE EXISTENCE AND UNIQUENESS OF APPROXIMATION OF OPTIMAL TIME REPLACEMENT OF INDUSTRIAL EQUIPMENT FOR A TRUNCATED CONTINUOUS MODEL

Ezekafor S. C.

Department of Civil Engineering,  
Chukwuemeka Odumegwu Ojukwu University,  
P.M.B 02 Uli,  
Anambra State, Nigeria.  
Email: [odicomatics@yahoo.com](mailto:odicomatics@yahoo.com),  
+234-8033708784,  
+234-8036941434.

Okoli O.C.

Department of Mathematics,  
Chukwuemeka Odumegwu Ojukwu University,  
P.M.B 02 Uli,  
Anambra State, Nigeria.

Agunwamba J.C.

Department of Civil Engineering,  
University of Nigeria Nsuka

## Abstract

*The purpose of this paper is to develop an approximate method of determining the appropriate optimal time to replace the equipment which repair and maintenance cost increase and their efficiency reduce with time for a continuous model. Furthermore, we sought to establish some existence and uniqueness theorem governing this optimal replacement time.*

**Keywords:** Scrap Value, Average annual cost, Running Cost, Replacement cost, Approximation and continuous model.

## INTRODUCTION

Replacement Problem (RP) is one of the key decision areas in engineering economic policy. In our daily life, replacement of an equipment or item is needed to maintain our desired efficiency level. Once equipment is designed, fabricated and installed, the operational availability of the same is looked after by the maintenance requirement. The idea of maintenance is very old and is believed to have been introduced along with the inception of the machine. In the early days, a machine was used as long as it worked. When it stopped working, it was either repaired or replaced. The replacement problems are concerned with the issues that arise when the performance of an item decreases, fail or breakdown occurs (Pranab & Surapati, 2011; Ajibola, 2014; Allen & Ching, 2005).

The solution to replacement problem is nothing but arriving at the best policy that determines the time at which the replacement is most economical instead of continuing at an increased maintenance cost.

Modeling of the replacement problem has attracted the interest of many authors. Nakagawa and Osaki (1977) introduced the age replacement problem. Bellman (1955) studied RP with dynamic programming. Hartman and Rogers (2006) extended dynamic programming approaches for equipment replacement problems with continuous and discontinuous technological change. Thi, yeung & Castanier (2010) discussed an optimal maintenance and replacement decisions under technological change. They used stochastic dynamic programming in dealing with the optimal maintenance and replacement policy of equipment as a function of performance and cost. Abdelwali (1997) discussed parametric multi-objective dynamic programming with application to automotive problems. Abdelwali, Eliamony, Murad & Al Rajhi (2014) studied optimum replacement policies and applied the concept for Kuwait Passenger Transport Company. They used dynamic programming technique for generating the optimal replacement policies for buses. Ahmed (2010) studied an algorithm for a deterministic RP. RP with different criteria have been studied by Alchian, 1952; Dreyfus, 1977; Wagner, 1975; Oakford, Lohmann & Salazar, 1984; Ohnishi, 1997; Dimitrakos & Kyriakidis, 2007.

The purpose of this paper is to develop an approximate method of determining the appropriate optimal time to replace the equipment which repair and maintenance cost increase and their efficiency reduce with time for a continuous model. Furthermore, we establish some existence and uniqueness theorem governing this optimal replacement time.

## PRELIMINARIES: CONTINUOUS TIME MODEL

In replacement policy of continuous time model for items which running cost increases with time and value of money remains constant during a period, we denote

$R(t)$ : Running cost of equipment at time  $t$ .

$R(t; t_0)$ : Running cost of equipment at time  $t$  after some time  $t_0$ .

$C$ : Capital cost of equipment

S: Scrap (salvage) value of equipment at the end of year t.

Thus, the running cost incurred during the t years  $N(t)$  is given by

$$N(t; 0) = \int_0^{t_0} R(\eta; t_0)d\eta + \int_{t_0}^t R(\eta; t_0)d\eta \quad \forall t_0 \geq 0$$

(2.1)

Where  $t_0$  is any time ( $t_0 \geq 0$ )

If we assumed that the running cost was truncated after some time  $t_0$  then (2.1) becomes

$$N(t; t_0) = \int_{t_0}^t R(\eta; t_0)d\eta \quad \forall t_0 \geq 0$$

(2.2)

Then the total cost  $TC(t; t_0)$  incurred on the equipment during the (truncated) t years is given by

$$TC(t; t_0) = C - S + \int_{t_0}^t R(\eta; t_0)d\eta$$

(2.3)

Hence, the average cost  $AC(t; t_0)$  is given by

$$AC(t; t_0) = \frac{1}{t - t_0} \left[ C - S + \int_{t_0}^t R(\eta; t_0)d\eta \right]$$

(2.4)

Observe that if  $t_0 = 0$ , then equation (2.2), (2.3) and (2.4) reduces to the special cases  $N(t)$ ,  $TC(t)$ , and  $AC(t)$  which are given by

$$N(t) = N(t; 0) = \int_0^t R(\eta)d\eta$$

(2.5)

$$TC(t) = TC(t; 0) = C - S + \int_0^t R(\eta)d\eta$$

(2.6)

$$AC(t) = AC(t; 0) = \frac{1}{t} \left[ C - S + \int_0^t R(\eta)d\eta \right]$$

(2.7)

We seek for the value of t that minimizes  $AC(t; t_0)$  in (2.4) which is a generalization of (2.7) studied in [1-3]. Using differential calculus, we have that

$$\frac{d}{dt} [AC(t; t_0)] = \frac{-1}{(t-t_0)^2} \int_{t_0}^t R(\eta; t_0)d\eta + \frac{R(t; t_0)}{t - t_0} + \frac{S - C}{(t - t_0)^2}$$

by optimality condition, we have that

$$\frac{-1}{(t-t_0)^2} \left[ C - S + \int_{t_0}^t R(\eta; t_0)d\eta \right] + \frac{R(t; t_0)}{t - t_0} = 0$$

(2.8)

which implies that

$$\begin{aligned} R(t; t_0) &= \frac{1}{t-t_0} \left[ C - S + \int_{t_0}^t R(\eta; t_0) d\eta \right] \forall t > t_0 \\ &= AC(t; t_0) \end{aligned} \quad (2.9)$$

Thus, by (2.9) it implies that the (truncated) average running cost  $AC(t; t_0)$  is optimal (minimal) when the (truncated) running cost at the time  $t$ ,  $R(t, t_0)$  is equal to the average running cost for the period of time  $t$ . Equation (2.9) is actually the replacement criteria/policy

Furthermore, in (2.9) if  $t_0 = 0$ , we have

$$R(t) = \frac{1}{t} \left[ C - S + \int_0^t R(n) d\eta \right] \quad (2.10)$$

Hence, (2.10) is a replacement criteria/policy that is a consequence or corollary to replacement criteria/policy in (2.9).

## MAIN RESULTS/APPROXIMATION METHOD

### Lemma 3.1.1 (Existence Theorem) [19]

Let  $f: [a, b] \rightarrow R$  be a continuous function and  $y \in (f(a), f(b))$  then there exists  $x \in (a, b)$  such that  $f(x) = y$ .

### Lemma 3.1.2 (Uniqueness Theorem) [19]

If  $f$  belongs to  $C^2(R)$  is increasing, is convex and has a zero, then the Newton's iteration scheme converges uniquely to the zero of  $f$ .

**Remark 3.1.3** A consequence of lemma 3.1 as applied in this work, is the case where  $y = 0$ , as such  $f$  must have a zero in the interval  $(a, b)$ . Since  $f(a)f(b) < 0$ , the function changes sign on the interval  $[a, b]$ , hence, there exists at least one zero  $x \in (a, b)$  such that  $f(x) = 0$  [18-19].

Since  $R(t; t_0)$  is a continuous function of time which is assumed to be differentiable, thus there exists  $a_k$ , a constant for every  $k \geq 0$  such that

$$R(t; t_0) = \sum_{k=0}^n \frac{a_k (t-t_0)^k}{k!} \text{ for some } n \in \mathbb{N} \quad (2.11)$$

$$\text{Where } a_k = R^{(k)}(t; t_0) = \left. \frac{d^k R(t; t_0)}{dt^k} \right|_{t=t_0}$$

For simplicity, we may assume that  $n = 2$  and  $t_0 = 0$ , so that

$$R(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$$

Now, in general, using (2.8) and (2.11) we have

$$\begin{aligned} \sum_{k=0}^n \frac{a_k(t-t_0)^k}{k!} &= \frac{1}{t-t_0} \left\{ \int_{t_0}^t \sum_{k=0}^n \frac{a_k(\eta-t_0)^k}{k!} d\eta + C - S \right\} \\ &= \frac{1}{t-t_0} \left\{ \sum_{k=0}^n \int_{t_0}^t \frac{a_k(\eta-t_0)^k}{k!} d\eta + M \right\}; \quad M = C - S > 0 \\ &= \frac{1}{t-t_0} \left\{ \sum_{k=0}^n \frac{a_k(\eta-t_0)^{k+1}}{(k+1)!} \Big|_{t_0}^t + M \right\} \\ &= \frac{1}{t-t_0} \left\{ \sum_{k=0}^n \frac{a_k(t-t_0)^{k+1}}{(k+1)!} + M \right\} \\ &= \sum_{k=0}^n \frac{a_k k (t-t_0)^{k+1}}{(k+1)!} - M \end{aligned} \tag{2.12}$$

$$\text{Let } f(t; t_0, n) = \sum_{k=0}^n \frac{a_k(t-t_0)^{k+1}}{(k+1)!} - M \tag{2.13}$$

**Theorem 3.1.4**

Let  $f(t; t_0, n)$  be given by (2.13) then there exist  $t^* \in [t_0, t_0 + \varepsilon]$  for some  $\varepsilon > 0$  such that  $\int(t; t_0, n) = 0$  for every  $n \in \mathbb{N}$ .

**Proof**

We can choose  $\varepsilon > 0$  so that

$$f(t_0 + \varepsilon) = \sum_{k=0}^n \frac{a_k \varepsilon^{k+1}}{(k+1)!} - M > 0$$

If  $\varepsilon \in (0, 1)$ , then

$$\begin{aligned} 0 < \sum_{k=0}^n \frac{a_k k \varepsilon^{k+1}}{(k+1)!} - M < \varepsilon \sum_{k=0}^n \frac{a_k k}{(k+1)!} - M \\ \varepsilon > M \left( \sum_{k=0}^n \frac{a_k k}{(k+1)!} \right)^{-1} \end{aligned}$$

if  $\varepsilon \in (1, \infty)$ , then

$$\begin{aligned} 0 < \sum_{k=1}^n \frac{a_k k \varepsilon^{k+1}}{(k+1)!} - M < \varepsilon^{k+1} \sum_{k=0}^n \frac{a_k k}{(k+1)!} - M \\ \varepsilon > \left[ M \left( \sum_{k=0}^n \frac{a_k k}{(k+1)!} \right) \right]^{-1} \end{aligned}$$

Now, we define

$$\varepsilon^* = \sup \left\{ M \left( \sum_{k=0}^n \frac{a_k k}{(k+1)!} \right)^{-1}, \left[ M \left( \sum_{k=0}^n \frac{a_k k}{(k+1)!} \right) \right]^{-1} \right\}$$

and take  $\varepsilon = [\varepsilon^*]$  (where  $[.]$  is the greatest integer function)

Hence, for such  $\varepsilon > 0$ , we take  $t = t_0 + \varepsilon$ , so that  $f(t) > 0$  and  $f(t_0) = -M < 0$  (since  $M > 0$ ).

We therefore, conclude by lemma 3.1.1 that there exist  $t^* \in [t_0, t]$  such that  $f(t^*) = 0$

By (2.8),  $t^*$  is the optimal time that minimizes the average running cost of the equipments.

This completes the proof.

**Estimation of  $t^*$**

For practical purpose,  $t^*$  can be estimated using any of the method of finding the zeros of a nonlinear equation if a closed-form solution fail to exist. In particular using the Newton’s approximation method we define.

$$t_{j+1}^* = t_j - \frac{f(t_j^*)}{f'(t_j^*)} \quad \forall j \geq 0$$

(2.14)

Where  $t_0^* \in [t_0, t]$  is any initial guess that is sufficiently close to  $t^*$  and satisfy

$$|t_{j+1}^* - t^*| \leq C |t_j^* - t^*|^2 \quad \forall j \geq 0$$

(2.15)

Now, to establish the uniqueness of  $t^* \in [t_0, t]$ , observed that

1.  $f(t, t_0) \in C^2(\mathcal{R})$
2.  $f''(t; t_0) > 0 \quad \forall t > t_0 ; [ f \text{ is convex on } (t_0, \infty) ]$
3.  $f'(t; t_0) > 0 \quad \forall t > t_0 ; [ f \text{ is increasing on } (t_0, \infty) ]$

Then the Newton’s iteration scheme in (2.14) converges uniquely to  $t^* \in (t_0, t)$  which is the optimal replacement time for the continuous model.

**Example**

Suppose  $R(t) = \alpha(t - t_0)^\beta$  where  $\alpha > 0, \beta \geq 2$ .

Then we have  $f(t, t_0) = \frac{\beta\alpha(t-t_0)^{\beta+1}}{\beta+1} - M$ .

There exist  $\varepsilon > 0$  such that  $f(t_0 + \varepsilon) > 0$  and  $f(t_0 + \varepsilon) = \frac{\beta\alpha\varepsilon^{\beta+1}}{\beta+1} - M > 0$

$$\varepsilon > \left( \frac{M(\beta+1)}{\beta\alpha} \right)^{\frac{1}{\beta+1}} > 0$$

Then there exist  $t^* \in (t_0, t_0 + \varepsilon_0)$  such that  $f(t^*, t_0) = 0$

$$\frac{\beta\alpha(t^* - t_0)^{\beta+1}}{\beta+1} = M; \quad \Rightarrow \quad t^* = \left( \frac{M(\beta+1)}{\alpha\beta} \right)^{\frac{1}{\beta+1}} + t_0$$

Where  $\varepsilon_0 = \text{Inf} \left\{ \varepsilon : \varepsilon > \left( \frac{M(\beta+1)}{\alpha\beta} \right)^{\frac{1}{\beta+1}} \right\}$

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# MODELING LIQUID WATER ABSORPTION OF UNTREATED RAMIE FIBER DURING SOAKING

Onukwuli O.D.

Department of Chemical Engineering  
Nnamdi Azikiwe University Awka ,  
Phone number: 08063635864  
E-mail: [onukwuliod@yahoo.com](mailto:onukwuliod@yahoo.com),

Okoronkwo G.O.

Department of Chemical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08063791192  
E-mail: [ogeoronyeka@gmail.com](mailto:ogeoronyeka@gmail.com)

Uyaelumuo A.E.

Department of Mechanical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08038378509  
E-mail. [tonychristus@gmail.com](mailto:tonychristus@gmail.com)

## Abstract

*Liquid water absorption of untreated ramie fiber during soaking in liquid water at temperatures of 10, 20, 30, 40,50°C was simulated using peleg's model. The weight-gain during soaking process was determined in terms of moisture content. Peleg's equation was adequately capable to predict water uptake of untreated ramie fiber under the experimental conditions. The peleg rate constant,  $k_1$ , decreased from  $32.53 \cdot 10^{-2}$  to  $9.59 \cdot 10^{-2} \text{h}^{-1}$  while capacity constant,  $k_2$ , did not with increasing temperature. The effective diffusivity was evaluated by fitting experimental absorption data to Fick's second law of diffusion. Effective diffusivity of water varied from  $9.5471 \cdot 10^{-9}$  to  $1.9094 \cdot 10^{-9}$  over the temperature range studied with an energy activation of  $29,323.478 \text{KJmol}^{-1} \text{K}^{-1}$ . The temperature dependence of the diffusivity coefficient was described satisfactorily by Arrhenius-type relationship.*

**Keywords:** Liquid water, peleg's model, untreated ramie fiber, pretreatment and extraction

## INTRODUCTION

Untreated Ramie Fiber plant is an important plant in tropical Africa. It is made mainly of cellulose materials for people living in that area. In developing countries, the commercial processing of this locally grown plant into added products is an important driver for economic development. Recently, there has been a growing research in ramie plant with respect to its potentials for composite production. In the composite production process, carefully arranged ramie fibers were soaked in water until saturation before composite production in order to be able to determine its water absorption capacity in composite production process, soaking time and temperature had a highly significant effect on composite quality. Soaking in water is also both pretreatment and extraction process for the composite production process. The kinetics of water absorption has been studied extensively for traditional food fiber plant (Abu-Ghannam & McKenna, 1997; Hung et al, 1993; Sopade et al, 1992). Mathematical modeling of absorption in composite production processes is very important in the design and Optimization of its fiber liquid water hydration predictions. These models may be theoretical, empirical and semi-empirical, but despite the wide application of computers and their associated programs, empirical equations are extensively employed because of their ease of computation and simplicity (Sopade et al, 2007). Peleg's equation is a popular empirical non-exponential model with parameters of immense practical importance in hydration kinetics applicable to weight gain during rehydration (Peleg, 1988; Cunningham et al, 2007; Singh and Kulshrestha). Peleg two-parameter equation accuracy prediction during water soaking was tested with its original form as in Eq. (A), rearranged to Eq. (B)

$$M_t = M_0 + \frac{t}{K_1 + K_2 t} \quad (A)$$

$$\frac{t}{M_t - M_0} = K_1 + K_2 t \quad (B)$$

Hence, absorption rate at the beginning of soaking process is subsequently expressed as  $K_1$  is lined to initial liquid water absorption rate,  $W_0$  (Peleg 1988).

$$W_0 = \frac{dM}{dT} \Big|_{t \rightarrow 0} = \frac{1}{K_1} \quad (C)$$

Peleg capacity constant,  $K_2$ , relates to maximum moisture content. As  $t \rightarrow \infty$ , Eq. (D) shows the equilibrium moisture content ( $M_c$ ) and  $K_2$  relationship:

$$M_e = M_0 + 1/K_2 \quad (D)$$

To the authors' knowledge there is no information about soaking of untreated ramie extracted fiber. Hence, the evaluation of physical properties of untreated ramie fiber and the applicability of Peleg's equation in modeling liquid water absorption, determination of the diffusivity and activation energy at different temperatures was studied.

## MATERIALS AND METHODS

### Sample preparation

Ramie plant stems got from northern Nigeria in 2014 were extracted of its fiber at GeoMela CCRD. Samples were dried and stored at room temperature until experiments. Official AOAC (2006) methods were used to determine its biochemical properties. The experiments were conducted in five different stages at 10 rounds each.

### Determination of Physical properties

In order to determine dimensions, untreated ramie fibers were chopped at same lengths and possess same thickness (Diameters), all were measured with the help of an electronic digital caliper having a resolution of 0.01mm. Untreated ramie fiber geometric mean diameter ( $G_{md}$ ) and degree of sphericity ( $\phi$ ) were calculated using the relationship below (Kashaninejad et al, 2006):

$$(E) \quad G_{md} = (LWH)^{1/3} = (AL)^{1/3}$$

$$\phi = \pi^{1/3}(6Vp)^{2/3}/Ap(F)$$

### Determination of liquid water absorption kinetics

To determine the kinetics of liquid water absorption, one gram of sample was weighed and soaked in a known weight of distilled water at five different temperatures 10,20,30,40 and 50oC for a known period of time. At the soaking processes, samples were periodically removed from the incubator and weighed using an electronic balance (END, 0.0001gr, China). At each five minutes interval, the water content of the untreated ramie fiber were calculated as the percentage ratio of the difference between the weight of the dry solid and wet samples to the weight of the dry samples. The variations of the moisture content of the samples with time were used to plot the kinetic curve of samples moisture.

### Determination of the effective diffusivity and activation energy

The elimination of the effect of the fiber radius on the constant rate of diffusion, the effective diffusivities were calculated in analogy to the analytical solution of one dimensional Fick's law of diffusion with constant moisture diffusivity for sphere given by (Kaptso et al, 2008). With respect to this, the equation below was used:

$$K = \frac{\pi \cdot D_{eff}}{r^2} \quad (G)$$

The reciprocal of absolute temperature were correlated with the obtained diffusivity according to Arrhenius type Eq. (H) and the activation energy was calculated by linear regression of Ln ( $D_{eff}$ ) verse 1/T:

## RESULTS AND DISCUSSION

### I. Physico-chemical properties of ramie fiber

Few physico-chemical properties of ramie fiber are in Table 1 below. The length, radius, area, sphericity and geometric mean diameter of the fiber sample were calculated.

Table 1: Average physico-chemical analysis of ramie fiber

Parameters	Analyzed quantity
Moisture content	2.410%
Ash	0.986%
Length	100mm
Radius	$3 \times 10^{-3}$ mm
Area	$2.8278 \times 10^{-5}$ mm <sup>2</sup>
Sphericity	5%
Geometric mean diameter	0.9805mm

### II. Kinetics of Liquid Water Absorption

The moisture content (on a dry weight basis) of ramie fiber calculated at five soaking temperatures (10°C-50°C) during hydration processes are shown in the Figures below. A regular increase in water absorption was observed as temperature and soaking time increased. This phenomenon is due to high rate of water diffusion at higher temperature and time. The same observations goes with other studies (Obekpa et al, 1990; Tangratanavalee et al, 2002; Chiang et al, 2002; Moreira et al., 2008 and Kaptso et al., 2008). These figures depicts that the rate of water absorption is initially rapid and then slows down as equilibrium approaches showing some kind of asymptotic behavior relative to the decrease of driving force in liquid water transfer hydration system close to equilibrium. These effects were similar during liquid water soaking of cellulosic materials (Bello et al., 2004 and Solomon, 2007) as the liquid water absorption data of the ramie fiber samples in terms of moisture content and its soaking time under the experimental conditions were fitted to Peleg's equation (Eq.A).

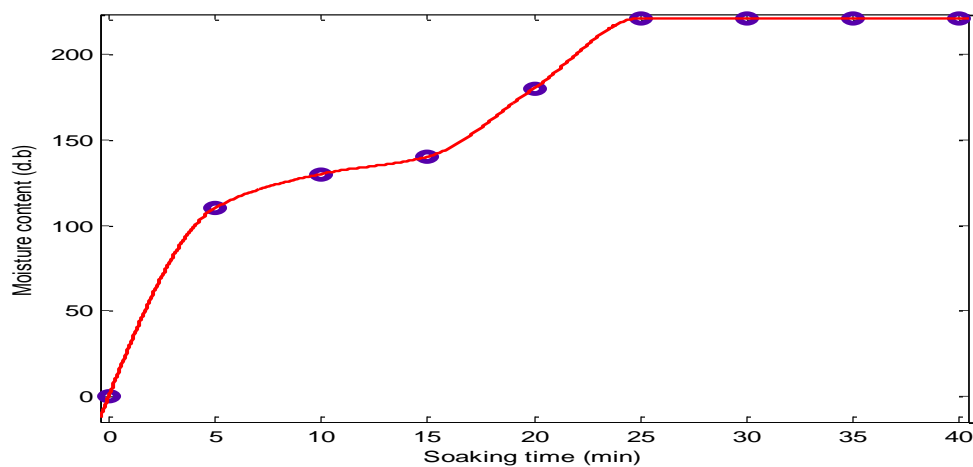


Figure1

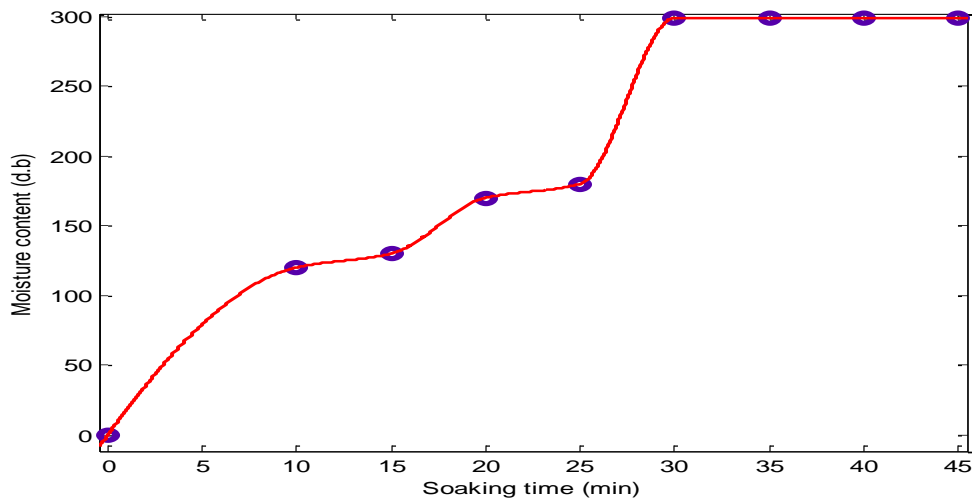


Figure 2

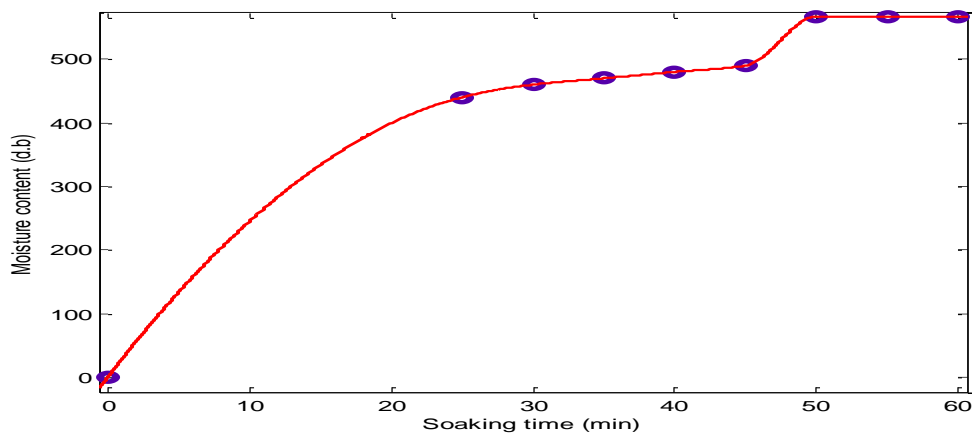


Figure 3

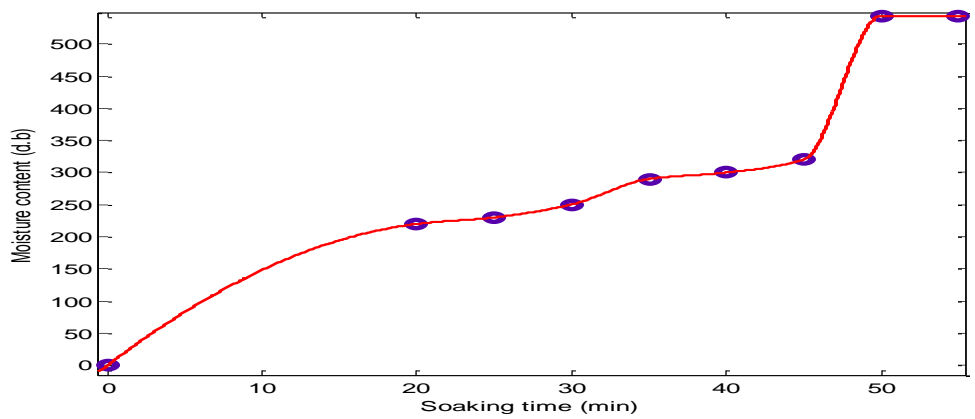


Figure 4

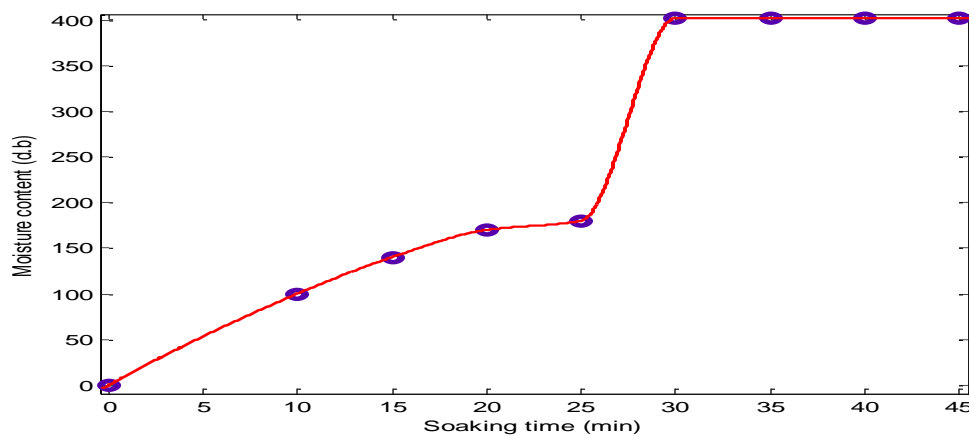


Figure 5

### III. The Constant Rate of Water Absorption

The Plots of  $t/(M_t - M_o)$  versus soaking time ( $t$ ) in the figures below allows to study the characteristics of Peleg's constants. The Peleg's rate constant ( $k_1$ ) and capacity constant ( $k_2$ ) determined at different temperatures are presented in Table 2. The f-statistic and t-statistic values from the optimization process confirm the adequacy of the model for describing the water absorption kinetics of untreated ramie fiber within the studied temperature range. In this work,  $K_1$  values were inversely related to temperature indicating the increase in the water absorption rate at higher temperatures. This result is in agreement with previous studies (Obekpa et al, 1990; Sopade et al., 1992; Hung et al., 1993; Abu Ghannam and McKenna 1997; Turhan et al., 2002; Resio et al., 2006).

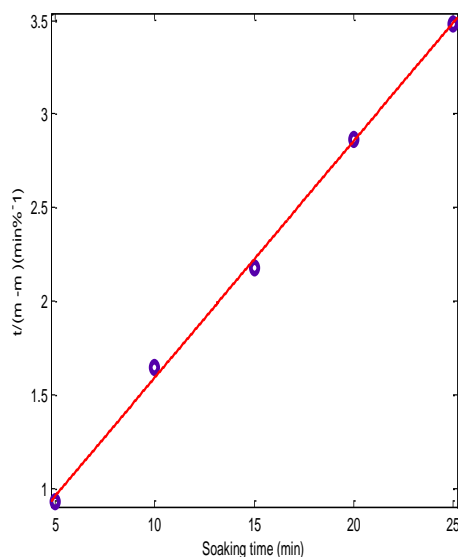


Figure 1

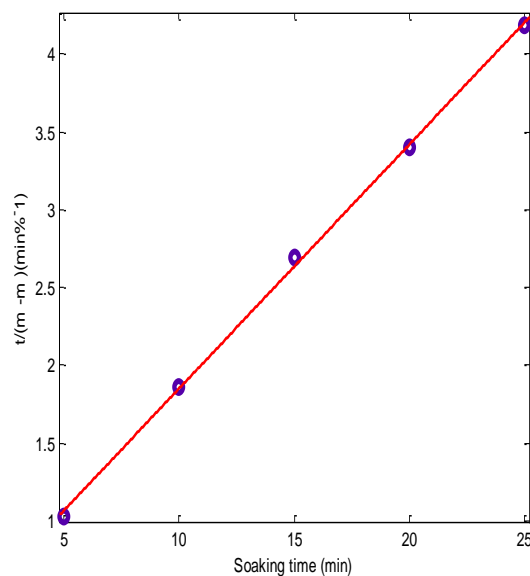


Figure 2

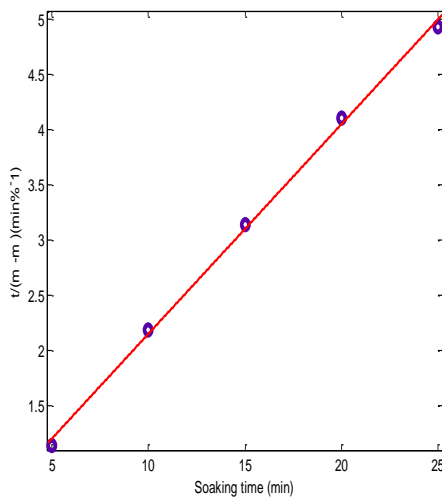


Figure 3

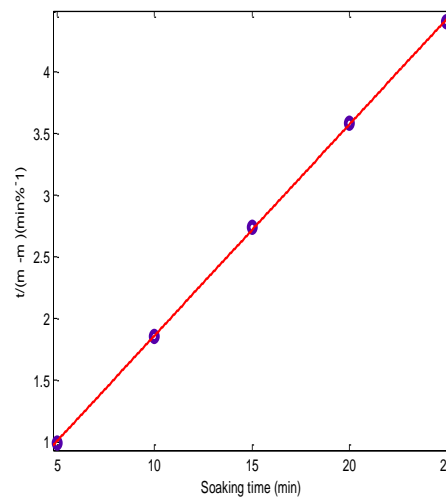


Figure 4

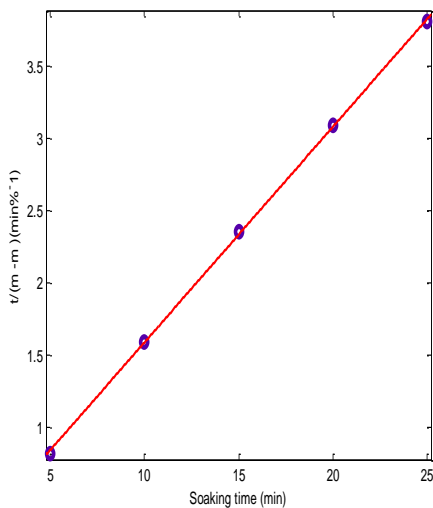


Figure 5

Table 2: Average Peleg's constants and equilibrium moisture content of untreated ramie fibers

	T(°C)	$K_1 \cdot 10^{-2} (\text{h}\%^{-1})$	$K_2 \cdot 10^{-2} (\%^{-1})$	Me(d.b)
10	32.53	12.65	792.9238	
20	27.48	15.72	638.5423	
30	25.47	18.96	529.8362	
40	14.55	17.13	586.1812	
50	9.59	14.91	673.1008	

It is observed that the Peleg's constant  $K_2$  for untreated ramie fiber cannot be a function of temperature (Fig. 3). Similar trends have been observed for other workers (Sopade and Obekpa, 1990; Hung *et al.*, 1993) that reported that  $K_2$  can be independent of temperature.

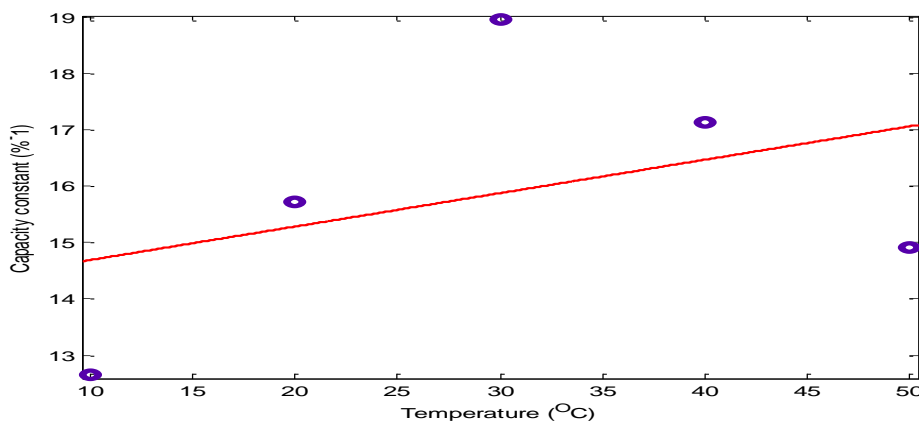


Figure 6

Table 2 shows the constant  $K_2$  fluctuating from 12.65 to 14.91 while the soaking temperature increased from 10 to 50°C. This is due to the uncertainty in liquid water absorption capacity of ramie fiber with increase in temperature. This statement clearly confirms that as soaking temperature increases the equilibrium moisture content of ramie fibers may or may not increase.

**IV. Effective diffusivity and activation energy**

The effective diffusivity of fibers calculated by Eq. (G) is shown in Table 3. The effective diffusivity of the fibers increased from  $1.9094 \times 10^{-9}$  to  $9.5471 \times 10^{-9} \text{ m}^2 \text{ s}^{-1}$  as the soaking temperature increased from 10 to 50°C. The comparison of the diffusion coefficients for water soaking obtained in this study for ramie fiber with those reported in the literature for cellulosic materials depict that the effective diffusivity of ramie fiber is very similar to other agricultural materials (Resio *et al*, 2006; Bello *et al*, 2004).

Table 3: Arrhenius parameters for liquid water absorption of untreated ramie fiber

Temperature(°C)	Diffusion coefficient ( $\text{m}^2 \text{s}^{-1}$ )
10	$1.9094 \times 10^{-9}$
20	$2.3869 \times 10^{-9}$
30	$3.1824 \times 10^{-9}$
40	$4.7721 \times 10^{-9}$
50	$9.5471 \times 10^{-9}$

The logarithm of  $D_{eff}$  as a function of reciprocal of absolute temperature (T) is plotted below. The results show a linear relationship between (log  $D_{eff}$ ) and (1/T) or an Arrhenius-type relationship (Eq. H). The diffusivity constant ( $D_0$ ) and activation energy ( $E_a$ ) calculated from the linear regression were  $4.2221 \times 10^{-4} (\text{m}^2 \text{ s}^{-1})$  and  $29,323.478 (\text{KJmol}^{-1} \text{K}^{-1})$ , respectively. The obtained activation energy is reasonable data comparable with several authors, for instance (Kaptso, *et al* 2008), (Resio, *et al*. 2006) (Solomon, 2007) and (Maskan, 2002).

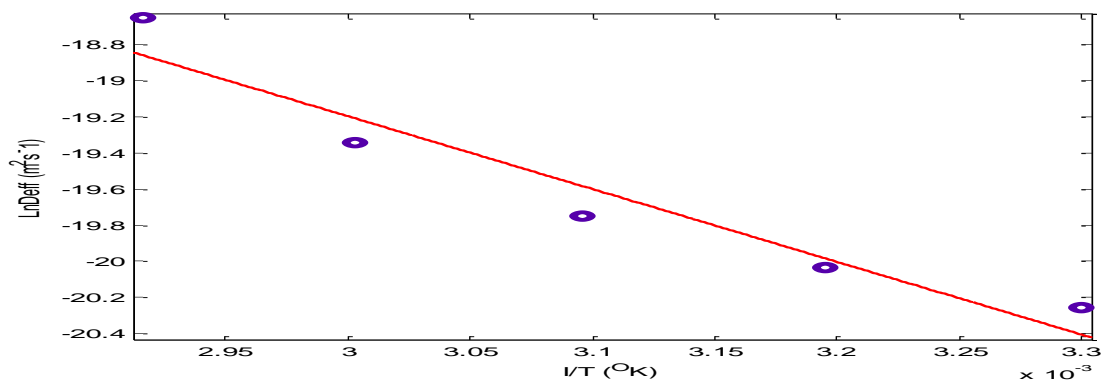


Figure 7

## CONCLUSION

Peleg's equation successfully represented the liquid water absorption behavior of untreated ramie fibers during the soaking process at different temperatures and could be used to estimate the moisture content at given soaking time and temperature within the experimental condition studied. The Peleg's constants  $K_1$  were a function of temperature and decreased with increase in soaking temperature while  $K_2$  was not for untreated ramie fiber. The effective diffusivity of untreated ramie fiber increased with increase in temperature in respect to the Arrhenius type relationship which the activation energy can be calculated. This work revealed that it is possible to model the liquid water absorption characteristics of untreated ramie fiber which assists to optimize soaking conditions.

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# **PUBLIC POLICY OBJECTIVES AND ITS IMPLEMENTATION IN NIGERIA: A STUDY OF NATIONAL EMERGENCY MANAGEMENT AGENCY (NEMA)**

Eugene Nweke, Ph.D.

Department of Political Science  
Ebonyi State University, Abakaliki, Ebonyi State  
08096772293

Anthony Ngonadi

Department of Political Science, Tansian University,  
Umunnya Anambra State, Nigeria  
Email: mantony47@yahoo.com  
Phone: 08138220901, 08156667049

Ann Ezenwajiaku

Department of General Studies,  
Nigerian Television Authority College, Jos  
Plateau State  
08036927032

## **Abstract**

*This paper analysed the policy objectives of the National Emergency Management Agency (NEMA). It started by reviewing how Nigeria has suffered from the clutches of disasters. The report then moved on to policy justification where it discussed the rationale behind the formation of NEMA which was as a result of the devastating effects of disasters in Nigeria. From there it went on to give an overview of the Agency, stating how NEMA was formed and the aims of the agency. This report also discussed the methods through which NEMA implements their policies and objectives; the outcome that emanates as a result of the implementation of these policies and the underpinning factors that have informed the underperformance of NEMA. The report finally concluded with some recommendations that might help enhance the effectiveness and efficiency of NEMA, when rightly implemented.*

**Keywords:** Public policy, NEMA, disaster, NERA, policy implementation

## INTRODUCTION

The design of an organisation's response systems are political, jurisdictional, environmental, historical, economical etc. Therefore comparisons between systems are difficult, because of the variables involved. Nigeria is fondly called 'the giant of Africa'. As the most populated country (180 million) in Africa, it has an expansive coastline of about 973,768sq km. Geographical features such as the expansive Belts of hills and Plateaus in the middle Belt and North East, extensive Niger Delta and a vast and land further North makes it one of the most difficult and expensive terrains to manage disasters or conduct search and rescue. Nigeria as a country has suffered a lot from the problem of disaster. The World Disaster Report (a publication of the International Federation of Red cross and Crescent societies, 2002 edition) gave an annual average of people killed and affected by disasters in Nigeria as 96,786, representing 0.09% of people killed and affected by disasters in the world.

## POLICY JUSTIFICATION

According to news reports, Nigeria as a nation has suffered from its own share of disaster occurrences for example between 1992 to 2000, Nigeria recorded about 400 major fire and aircraft disasters involving more than 10,000 people with death toll of about a thousand-plus and the quantum of property destroyed was evaluated to be in of millions of dollars. These include flooding and soil erosion; while the man made ones include dam-failure, maritime disasters, bomb explosions, conflicts (occasioning displacement of victims), oil spillage, population explosion and air crashes. Nigerians have been lucky with earthquakes but not so fortunate with floods, pollution and oil spillages; ethnic disturbances such as ethnic conflicts between Hausa – Igbo and Yoruba – Hausa. The country has also had its fair share of air disasters. Farmlands and houses have been washed off by erosion in the Northern and Southern parts of the country; oil spillage have displaced the Ijaw fishermen and their farming counterparts have more or less been rendered jobless too because of the effects of the spillage on the ecosystem.

The loss of lives and the inefficient disaster management in Nigeria have really been a burden too hard for the government to carry. The problem has been compounded by the fact that the citizens lack the basic knowledge of health and safety as well as disaster avoidance technique. As a result of the inefficiency and obvious shortcomings in the management of disasters and in order to address the limitation in the scope of the operation of National Emergency Relief Agency NERA, and proffer solutions to the ineffective disaster response in the country, on the side of NERA which was established in by Decree 48 of 1976 by the Federal Government of Nigeria to fight the reoccurrence of disaster and the post effect of disaster which is death, the federal government of Nigeria held a meeting with stakeholders and leaders of NERA and the outcome metamorphosed to the formation of NEMA for effective management of disaster in Nigeria.

## **A BRIEF OVERVIEW OF NATIONAL EMERGENCY MANAGEMENT AGENCY (NEMA)**

The National Emergency Management Agency (NEMA) was established via Act 12 as amended by Act 50 of 1999, to manage disasters in Nigeria, it has its headquarters in Abuja and caters for the whole federation. The government of Nigeria in 1997, having realized the obvious shortcomings of National Emergency Response Agency (NERA) in the management of disasters, came up with a communiqué which noted the need to expand the functions of the National Emergency Relief Agency (NERA) to include proper management of disasters in the country.

From inception, NEMA's major functions are: tackling disaster related issues through the establishment of concrete structures and measures; formulation of policies on all activities relating to disaster management in Nigeria and co-ordination of plans and programmes for efficient and effective response to disasters at the National level using measures such as employment of experienced staff, education of the public in order to raise their level of awareness and reduce the effects of disasters in the country. The Agency has also put in place structures that enable it detect, respond and combat disasters in a timely manner.

The National Emergency Management Agency (NEMA) established by Act No. 12 of 1999 as amended is the government unit that has leadership responsibilities for the nation's disaster management. According to the provisions of Section 8 of the Act, communities and State Governments are expected to manage disasters that are within their levels of competence and resources. However, when the devastation is especially serious and exceeds the capabilities and resources of Local and State Governments, the Federal Government through NEMA will respond to such a disaster. NEMA has been placed at the centre of a network of disaster management organizations, liaising with them and coordinating their efforts. Thus the success or failure of disaster management in Nigeria depends largely on how well these institutions/organizations are working and how effectively NEMA is able to coordinate their efforts

NEMA has a mission statement through which they express what they intend to do which is to: "Coordinate resources towards efficient and effective disaster prevention, preparedness, mitigation and response in Nigeria". Further to its stated mission, NEMA has proposed a vision statement which it intends to achieve in the nearest future. This vision statement is to "build a culture of preparedness, prevention, response and community resilience to disasters in Nigeria

### **Aims**

"Aims are the starting point of policy, and the frame within which policy is set (Spicker 2006 p.57)." The aims of the National Emergency Management Agency in line with the enabling law as enumerated by the government are as follows:

- Formulate policy on all activities relating to disaster management in Nigeria and co-ordinate the plans and programmes for efficient and effective response to disasters at the National level.

- Monitor the state of preparedness of all organizations or agencies which may contribute to disaster management in Nigeria.
- Collate data from relevant agencies, so as to enhance forecasting, planning and field operations of disaster management.
- Educate and inform the public on disaster prevention and control measures
- Co-ordinate and facilitate the provision of necessary resources for Search and Rescue and other forms of disaster curtailment activities in response to distress calls.
- Co-ordinate the activities of all voluntary organizations engaged in emergency relief operations in any part of the federation.
- Receive financial and technical aid from international organizations and non-governmental Agencies, for the purpose of disaster management in Nigeria.
- Collect emergency relief supply from local and foreign sources and from International and non-Governmental Agencies.
- Distribute emergency relief materials to victims of natural or other disasters and assist in the rehabilitation of the victims where necessary.
- Liaise with State Emergency Management Committees, to assess and monitor, where necessary, the distribution of relief materials to disaster victims.
- Process relief assistance to such countries as may be determined from time to time.
- Liaise with the United Nations Disaster Reduction Organization or such other International bodies for the reduction of natural and other disasters.

Having seen the aim of the National Emergency Management Agency, one can argue vividly that the second and sixth policy objectives are related in the sense that if NEMA can Monitor the state of preparedness of all organizations or agencies which may contribute to disaster management in Nigeria and co-ordinate the activities of all voluntary organizations engaged in emergency relief operations in any part of the federation, it will lead to efficiency and better the outcomes of NEMA's operations in Nigeria. Having seen all the policy objectives of NEMA as mentioned above, one can say that some of them are either unrealistic or not easily attainable. For instance, the fact is that most states in Nigeria do not have a State Emergency Agency, how can NEMA Liaise with State Emergency Management Committees, to assess and monitor, where necessary, the distribution of relief materials to disaster victims? Secondly, the use of volunteers in disaster management in Nigeria is often faced with improper coordination; there is hardly any legal framework, umbrella, or regulatory commission that oversees their activities. In this case, NEMA cannot honestly claim that it co-ordinates the activities of all voluntary organizations engaged in emergency relief operations in any part of the federation.

## METHODS

"Methods should be relevant to the nature of the object we scrutinize and the aims and the perspectives of our examination (Sayer 1992 p.4)." Spicker, 2006 indicates that understanding approaches to methods is very important because it helps to explain where policies might have gone wrong and where they might still go wrong.

Having noted the aims of the agency, we are now going to note some of the methods that NEMA employs in the enactment of its policy objectives. NEMA has divided its offices amongst the six geo-political zones we have in Nigeria and these NEMA Zonal Offices serve as the eyes and ears of NEMA in their respective zones and coordinate NEMA's disaster operations therein. Accordingly, there are six NEMA Zonal Offices as follows:

- Kaduna Zonal Office to cover the North West Zone (Sokoto, Kebbi, Katsina, Zamfara, Kano, Jigawa and Kaduna States)
- Maiduguri Zonal Office to cover the North East Zone (Borno, Yobe, Adamawa, Bauchi, Taraba and Gombe States)
- Jos Zonal Office to cover the Central Zone (FCT, Niger, Plateau, Kogi, Benue, Kwara and Nasarawa States);
- Lagos Zonal Office to cover the South West Zone (Oyo, Ogun, Ekiti, Osun, Ondo and Lagos states);
- Port Harcourt to cover the South-South Zone (Akwa Ibom, Cross Rivers state, Delta, Bayelsa, Rivers and Edo States);
- Enugu to cover the South East Zone. (Enugu, Abia, Anambra, Imo and Ebonyi states).

The national Emergency Management Agency (NEMA) has formed the National Action Plan for Disaster Risk Reduction (2006-2015) which is ready for implementation in concert with other stakeholders (Audu, 2006).

## POLICY IMPLEMENTATION

"Implementation relates to 'specified objectives', the translation into practice of the policies that emerge from the complex process of decision making (Hill, 1997 p. 17)." Spicker, 2006 noted that implementation is what actually does happen. Implementation can also be seen as the carrying out, execution, or practice of a plan, a method, or any design for doing something. As such it is the action that must follow any preliminary thinking in order for something to actually happen. Edozien (2000) noted that the major problem in Nigeria as regards policies is not the lack of policy formulation but the implementation of policies. In fact so many laudable policies of NEMA never get to achieve the desired objectives for which they are formulated on account of default in implementation. In the modern public services, with its higher profile management, implementing a new policy is often seen as involving a comprehensive change, meaning not only changes in the services but also in organisational systems. Joyce (1999) indicated that it is relatively easy to talk or write convincingly about new policies but the problem arises with the need to move from starting the process to the proper implementation. He states that "implementation is very hard work, requiring

persistence, attention to detail and resilience to keep going in the face of setbacks". Spicker (2006) argues that policy is difficult to read. According to him, "it is always difficult to find out what a policy is, who has made decisions, and where a policy has come from." He went further to identify eight main stages in the policy process as recommended by the Australian policy makers they include: Identifying the issues, policy analysis, policy instruments, consultation, coordination, decision, implementation and evaluation. In most cases today, many policy makers do not follow this process to ensure successful implementation. Alabi (2000) noted that as long as patriotism, transparency and probity continue to decline in our country, we shall always reap economic and social woes. As long as Nigerians believe in the get-rich or die-trying syndrome, the menace of pipeline disaster will continue to be a reality. There have been more than a thousand attempts at the vandalizing pipelines in Nigeria since 1993.

## **OUTCOMES**

"Outcomes are changes that have happened as a result of the activity (Spicker, 2006 p.171)." After National Emergency Management agency has implemented its policy objectives, there is still a lot to be done to tackle this menace of disaster. From the information gathered from NEMA's website, the following are some of NEMA's achievements since its inception:

- NEMA said it has Established a Disaster Response Units (DRUs) to further enhance disaster management efforts nationwide. DRU's are designated military units established through the instrument of the National Disaster Response Plan (NDRP) and charged with the responsibility of providing immediate assistance to civil authorities to reduce further loss of lives and property as well as human suffering during a National Disaster.
- NEMA claimed that efforts are almost completed to put in place Hi-Tech facilities and other infrastructure for an improved and all encompassing disaster management system for our country. An example is the installation of the Cospas-Sarsat Technology.
- That they have procured helicopters for Search and Rescue during disaster which has enhanced search and rescue effort of the agency.
- NEMA indicated that most disasters result in high casualty rates because of the absence of an early warning mechanism. In this regard, NEMA has established an Early Warning Unit within the Department of Planning and Forecasting.
- The Agency has gone into collaborative pacts with Helicopter operators in the Country, NGOs, INGOs, International, regional and sub regional bodies and agencies for both capacity building, and technological enhancement in pursuit of a workable preparedness approach to curtailing disasters.

Having seen all these bogus achievement, it is still pertinent to note that NEMA is far from achieving its aims in totality. There are a lot of hurdles that NEMA and its policy objectives needs to cross before they can rightly say that they have achieved a lot in disaster management in Nigeria. Some of those constraints that showcase inefficiency on the part of NEMA include:

- Most times there is conflicting interest between NEMA and other agency like INGO and this has really negated the efficiency of both parties.
- Lack of proper coordinating channels between the Federal, State and Local Government Agencies. The progress which has been made at the Federal Level in the area of institutional arrangement has not been matched at the State, Local Governments and Community Levels. This is a big problem because it is at these lower levels that most disasters make their impact.
- Lack of implementation and enforcement of that could militate against disaster. Issues like urban master plans to counter floods and irrigation plan to counter drought.
- Incomprehensive disaster information date leads to miscalculation and wrong information being passed to the public by NEMA and that has really given them a bad image in the eye of the citizens
- Use of obsolete equipment like communication equipment and cars that are outdated for fighting disaster really hampers the successful operations of NEMA.
- There is the issue of inadequate funding for NEMA's activities like hazard assessment, vulnerability studies, risk assessment, forecasting and public awareness, affects the effectiveness of NEMA.

## **CONCLUSION**

Nigeria has suffered a lot from the menace of disaster. It is indeed posing a big threat to national security. Nigeria is suffers from a host of problems like deteriorating economic condition, low agricultural output, unemployment and general deterioration of the state of healthcare.

Added to all these, are occasional natural and frequent manmade disasters that further retard development. The leaders of the country tend to neglect or pay little attention to disaster issues and problems waiting until they have occurred with devastating consequences. It is therefore of utmost importance that we awaken our policy makers, government, civil society and the international community to evolve an effective comprehensive disaster management preparedness and response plan for the country.

It is also unfortunate to say that if you use other disaster management agencies in other countries to benchmark NEMA, you will still find out that they are seriously lagging behind in their activities and they are not living up to expectations.

The overall picture is that the National Emergency Management Agency, has not actually met its policy objectives.

Further to the above statement, there are some recommendations of what the National Emergency Management Agency should do in other to avert some of these impeding factors and work toward achieving its set aims and policy objectives. The following are therefore recommended:

- The Government of Nigeria should make it a point of duty to evolve an effective and comprehensive disaster management plan for the country.
- The Government should map out adequate funds for the running and operations of NEMA knowing full well that without proper funding, operations would definitely be crippled.
- They should also mobilize domestic and international resources for disaster reduction.
- NEMA should try and disseminate information on disaster resistant constructions methods for building and public works.
- NEMA should be able to point out some of those disaster prone areas and device programmes for possible, voluntary relocation to areas that are less disaster – prone.
- NEMA should collaborate with well known international disaster agencies like UN, UNICEF and other Local NGO's involved in disaster management
- NEMA have to try and Promote and encourage communities to participate in disaster preparedness planning in such areas as water and food storage, fuel and First Aid and in disaster prevention through activities that build a culture of safety.
- The Staff of NEMA should be adequately Trained and retrained from time to time in order to get them acquainted with the personnel involvement in disaster management.

If these mechanisms are properly implemented in the management of NEMA, it is envisaged that there would be a massive improvement in the operations of NEMA.

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# ANALYSIS AND MODELING OF ROAD TRAFFIC NOISE IN ONITSHA METROPOLIS, NIGERIA

Nwobi-Okoye C.C.

Department of Mechanical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08060013240

Uyaelumuo A.E

Department of Mechanical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08038378509  
E-mail: [tonychristus@gmail.com](mailto:tonychristus@gmail.com)

Okoronkwo G.O

Department of Chemical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08063791192  
E-mail: [ogeeonyeka@gmail.com](mailto:ogeeonyeka@gmail.com)

Duru C.A.

Department of Mechanical Engineering  
Chukwuemeka Odumegwu Ojukwu University Uli,  
Phone number: 08038662897  
e-mail: [donduru2014@gmail.com](mailto:donduru2014@gmail.com)

## Abstract

*Despite the enactment of legislations and efforts by the government to stem vehicular noise, the predominant source of noise pollution in urban areas, the noise exposure of people of Onitsha Metropolis, has hardly changed; rather it appears to increase by the day due to the growth of vehicular population. This study selected 12 areas for investigation; these are: 2 commercial centers, 3 road junctions/busy roads, 3 passenger loading parks and 2 high-density and 2 low density residential areas with noise measurements being done in the morning (8.am – 9.00am), at noon (11.00 – 12.00pm), during afternoon (2.00pm – 3.00pm) and in the evening (5.00pm – 6.00pm) to determine noise pollution all over the metropolis. Noise descriptors such as  $L_{10}$ ,  $L_{90}$ ,  $L_{Aeq}$ , TNI, NPL (LNP) and NC were assessed to reveal the extent of noise pollution due to heavy traffic and failures of some mechanical systems in the metropolis. The road junctions had the highest noise pollution levels, followed by commercial centres, passenger loading parks, high density residential area and finally low density residential area which were found to be much beyond the permissible limit (70dB during the day time). Chi-square ( $X^2$ ) test was also computed for investigated locations at different times to infer the level of significance. The tests depicts that the noise levels of different locations do not differ significantly at the peak hour. Again, prediction model was used to predict equivalent noise level. Comparison of predicted equivalent noise level with that of the actual measured data demonstrated that the model used for the prediction has the ability to calibrate the multi-component traffic noise and yield reliable result close to that by direct measurement. Many solutions proposed for noise control in the city are enumerated as a map of noise pollution was developed for Onitsha from the measured noise values.*

**Keywords:** Noise, Pollution, Analysis, Modeling, Noise map

## INTRODUCTION

The word "noise" is derived from the Latin word "nausea" meaning sickness. Noise can be defined as the level of sound that exceeds the acceptable level and creates an annoyance. Noise is any sound independent of loudness which can produce an undesired physiological or psychological effect in an individual or group. Noise is a major source of friction between individuals (Jobair et al., 2001).

The major sources of noise are industrial noise, community noise and traffic noise. Out of the three parameters, the source that affects the most is traffic or vehicular noise. In this traffic noise, almost two-third of the total noise pollution in an urban area is contributed by vehicular noise. Vehicle noise includes the following sources: engines exhaust systems, tyres interacting with the road, horns, aerodynamic friction and by the interaction between vehicles, sounds of cooling fans, gear boxes and brakes.

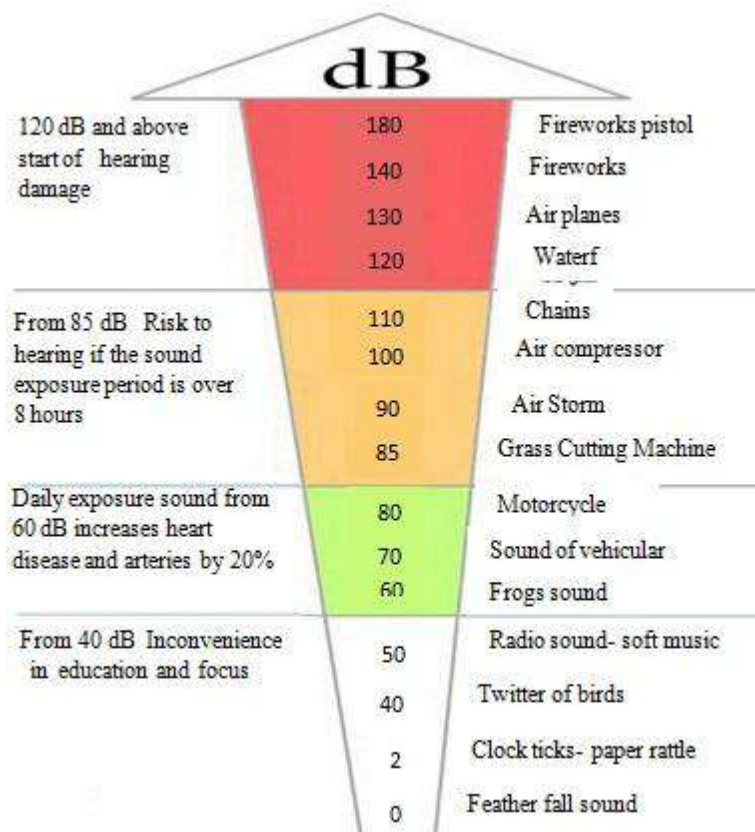


Figure 1: Noise Pollution; its Magnitude, Sources, and Effect

In general, Figure 1 schematically illustrates the magnitude of noise pollution, sources and its influence in human beings (Wael, 2008).

The most important factors raising noise pollution in urban areas include, inter alia, appliances, vehicular traffics, neighbourhood electrical appliances, TV and music systems, public address systems, railway and air traffic, and generating

sets. Everyone falls prey to the noise generated by the household equipment used by us (Singh and Daver, 2004).

Noise pollution, a by-product of urbanization and industrialization, is now recognized worldwide as a major problem for the quality of life in urban areas. The increase in the population and in the number of circulating vehicles has led to an increase in noise pollution, but noise pollution has been considered less than other contaminants in the environment (Mansouri et al., 2006).

Existing evidence indicating that noise pollution may have negative impact on human health has justified this research in order to provide better understanding of noise pollution problems and control (Georgiadou et al., 2004).

It was reported that the measurements of noise levels in residential, industrial, and commercial areas in New Delhi India, show that commercial areas have the highest noise levels, followed by industrial and residential areas (Braj and Jain, 1995).

It has been generally accepted that noise pollution, particularly road traffic noise, is severe in rapidly expanding cities, such as those of Southeastern Nigeria, where insufficient control is exercised and cities are poorly planned (Onuu, 1992). Noise pollution has been stated as a serious health hazard, with noise related damage to humans ranging from annoyance to difficulty in falling asleep and high blood pressure (Ugwuanyi et al., 2004; Saadu et al., 1998; Ahmad et al., 2006; Schwela and Zali, 1999).

In comparison with other pollutants, the control of environmental noise has been constrained by insufficient knowledge of its effects on humans and dose-response relationship, as well as by lack of sufficient data especially in developing countries like Nigeria. The effects of noise in developing countries are just as widespread as those in developed countries, and the long term consequences for health are the same. Practical actions to limit and control the exposure to environmental noise are therefore essential.

The noise pollution situation in Onitsha metropolis is similar to that in many urban areas. The city is relatively large, having rapid increase from 163,032 in 1963 to 261,604 in 2006 (NPC, 2006). The city has expanded continually in all directions in the past two decades. Many significant changes have been experienced in terms of urbanization, industrialization, expansion of road network and infrastructure. The city has been subjected to persistent road traffic and commercial activities due to overall increase in prosperity, fast development and expansion of economy. Very few studies have been carried out to investigate and assess noise pollution in Onitsha metropolis.

## **MATERIALS AND METHOD**

### **Materials**

Instrumentation for the field measurement consisted of precision grade sound level meter (according to ICC 651 AWSI 51.4 type),  $\frac{1}{2}$  in condenser microphone, and  $\frac{1}{3}$  octave filter with frequency range and measuring level range of 31.5Hz – 8KHz and 35 – 130dB, respectively.

Materials utilized include recording sheets, pen, pencil, graph paper and mathematical sets.

## METHODS

The research is based on the result of outdoor sound level (dB) meter measurements carried out in August, 2014 at 12 different locations (2 commercial centres, 3 road junctions and busy roads, 3 passenger loading parks, 2 high density residential areas and 2 low density residential areas).

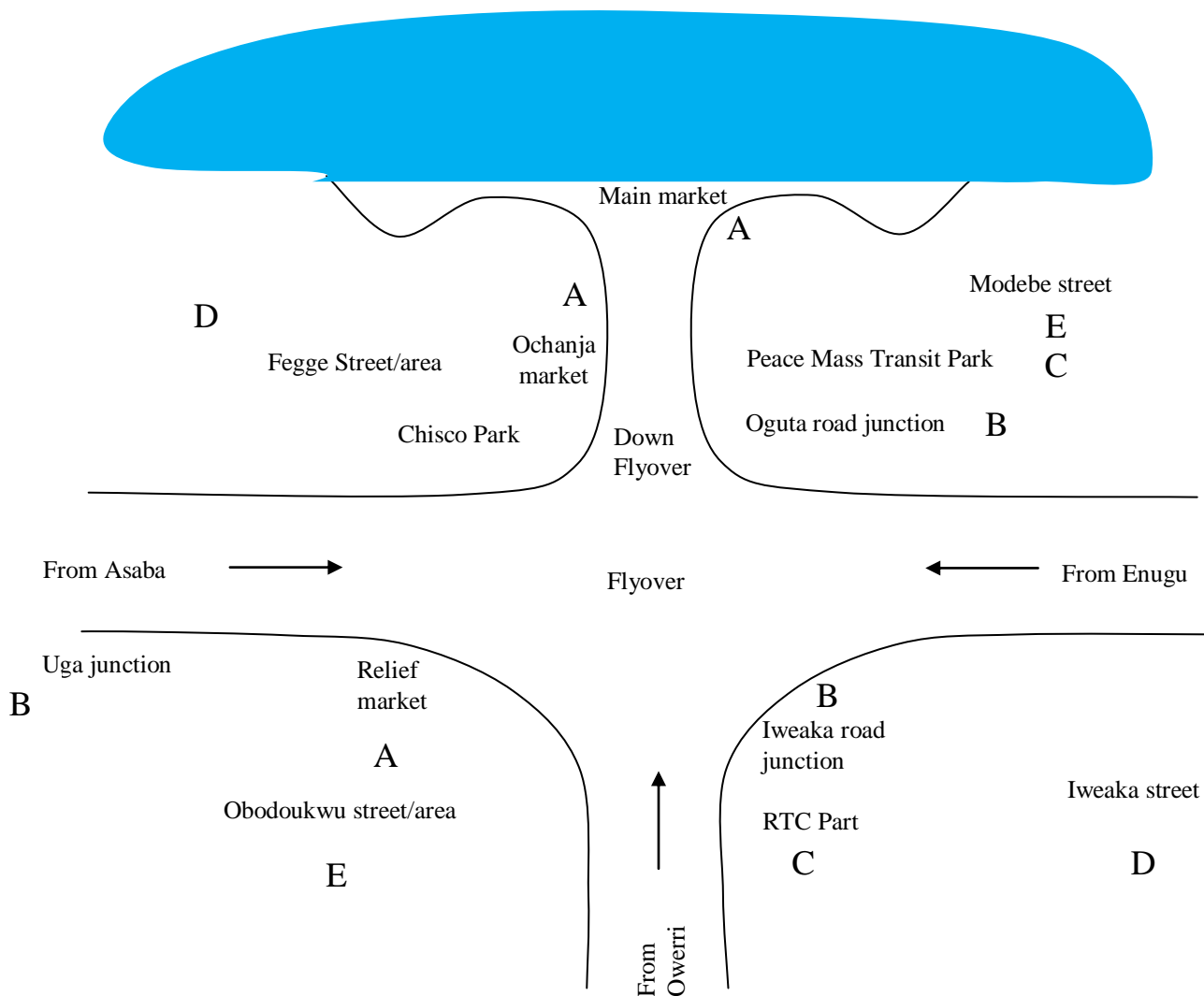


Figure 2: Onitsha Street guide showing the locations of the study area

Table 1: Selected locations for noise measurements in Onitsha metropolis

DESIGNATED NUMBER	LOCATIONS
<b>COMMERCIAL CENTRES (A)</b>	
1 (A <sub>1</sub> )	Ochanja market
2 (A <sub>2</sub> )	Relief market
<b>ROAD JUNCTIONS/BUSY ROADS (B)</b>	
3 (B <sub>1</sub> )	Upper Iweka road junction
4 (B <sub>2</sub> )	Oguta road junction
5 (B <sub>3</sub> )	Uga road junction by head bridge
<b>PASSENGER LOADING PARKS (C)</b>	
6 (C <sub>1</sub> )	Chisco park
7 (C <sub>2</sub> )	RTC park (New Tarzan)
8 (C <sub>3</sub> )	Peace Mass Transit park
<b>HIGH DENSITY RESIDENTIAL AREAS (D)</b>	
9 (D <sub>1</sub> )	Fegge street
10 (D <sub>2</sub> )	Iweka street
<b>LOW DENSITY RESIDENTIAL AREAS (E)</b>	
11 (E <sub>1</sub> )	Obodo Ukwu sreet
12 (E <sub>2</sub> )	Modebe street

The instruments were calibrated by the internal sound level calibrator before making measurement at each site. All the instruments comply with ICC standards.

The measurements were made at street level (of road junctions, market centres, motor parks, and residential areas). The instrument was held comfortably in hand with the microphone pointed to the noise source at a distance not less than 1m away from reflecting object.

LAI (A- weighed instantaneous sound pressure level) measurements were made and recorded at intervals 1 minute or 60 seconds for a period of one hour, giving 60 measured readings per sampling location.

This procedure was carried out for morning (8.00am – 9.00am), at noon (11.00 noon – 12.00pm), afternoon (2.00pm – 3.00pm) and evening (5.00pm – 6pm) measurements. The noise monitoring was done in a good climatic condition, where there was no sign of overcast clouds. Also, the monitoring was done during working days excluding Sundays and public holidays in order to get good results.

The noise levels of different squares in different time intervals were assessed along with their equivalent noise level (Leq). Leq represents the equivalent energy sound level of a steady state and invariable sound. It includes both intensity and length of all sounds occurring during a given period (Piccolo *et al.*, 2005 and Ozer *et al.*, 2009). Noise descriptors such as L<sub>10</sub>, L<sub>50</sub>, L<sub>90</sub> were also assessed to calculate the value of Leq using the formular,  $L_{eq} = L_{50} + (L_{10} - L_{90})^2 / 56$  as Leq is an insufficient descriptor of the annoyance caused by fluctuating noise. Noise pollution level (NPL) expressed in dB is also calculated by using the formular  $(NPL = L_{eq} + a(L_{10} - L_{90}))$  where a =1.0 (constant in the equation). NPL takes into account the variation in the sound signal and hence

serves as better indicator of the pollution in the environment for physiological and psychological disturbances of the human system. Noise Climate (NC) is the range over which the sound levels are fluctuating in an interval of time and is assessed using the formular ( $NC=L_{10}-L_{90}$ ).

Traffic Noise Index (TNI) is another parameter, which indicates the degree of variation in a traffic flow. This is also expressed in dB (A) and can be computed using the relation [ $TNI=4\{(L_{10}-L_{90}) + L_{90} -30dB (A)\}$ ]

Traffic volume is defined as the total number of vehicles passing through a fixed point on the road was counted. The ratio of heavy truck and buses to total traffic is called truck traffic mix ratio. This was computed in terms of percentage. Traffic volume count was manually done by counting the two and three wheelers (OKADA and KEKE-NAPEP), light motor vehicle (LMV) and heavy motor vehicle (HMV).

An increase in this ratio will increase the noise level. The noise level was computed by using the model of Griffiths and Landon, i.e.  $L_{eq} = L_{50} + 0.018(L_{10} - L_{90})^2$ . Where, the statistical percentile indicators were calculated with the following formulars;

$$L_{10} = 61 + 8.4\log (Q) + 0.15p - 11.5\log (d)$$

$$L_{50} = 44.8 + 10.8\log (Q) + 0.12p - 9.6\log (d)$$

$$L_{90} = 39.1 + 10.5\log (Q) + 0.06p - 9.3\log (d)$$

Where, Q is the vehicles flow, P is the percentage of heavy vehicles and d is the distance (1m in this study) of source receiver. The analysis of the measured noise level generally depicts that there are existence of variations of noise with variables as to time of the day, and locations etc. In order to determine the existence and statistical significance of these variations and trends, a cross classification analysis along with Chi-square ( $X^2$ ) test was assessed on the data.

This test was also used to test how well a set of observations fit a given distribution. It therefore, provided a test of goodness of fit. To test the significance of discrepancy between observed and calculated noise levels, regression analysis was applied. It enabled the researcher to know whether deviation measured from calculated values is not by chance but due to inadequacy of the theory to fit measured data.

**RESULTS AND DISCUSSION**

Table 2: Noise level (dB) visualized at 12 different selected areas at different time intervals of Onitsha metropolis

S/ N	Name of selected area	8.00 am - 9.00 am						11.00 am - 12.00 pm						2.00 pm - 3.00 pm						5.00 pm - 6.00 pm								
		Min	Max	Mean + SD	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	L <sub>frq</sub>	min	max	Mean + SD	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	L <sub>frq</sub>	min	max	Mean + SD	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	L <sub>frq</sub>	Min	Max	Mean + SD	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>
1	Ochanja	55.7	104.8	77.4 ± 7.7	79.4	78.4	74.7	57.5	105.6	76.8 ± 7.7	84.4	78.6	76.6	74.9	58.6	106.5	78.5 ± 8.0	84.4	78.5	76.7	74.4	59.7	107.2	79.1 ± 8.7	82.5	70.3	63.4	76.8
2	Relief	56.1	104.3	77.7 ± 7.6	79.6	77.6	74.1	56.3	105.7	78.3 ± 7.3	81.2	77.5	76.2	74.3	58.2	106.6	78.4 ± 8.2	84.4	78.4	76.4	74.1	59.3	108.3	79.6 ± 8.8	83.7	72.2	62.2	80.4

3	Upper Iweka	57 .2	1 0 6 .7	7 4 .3 ± 8 .6	7 8 1	6 8. 6	5 9. 6	7 4. 6	5 7. 6	10 5. 4	74. 5± 8.0	7 8. 2	6 7. 3	6 1. 6	7 2. 2	5 6. 1	10 4. 4	77. 2± 7.3	8 1. 7	6 8. 5	6 3. 4	7 4. 4	6 0. 4	10 6. 2	77 .6 ± 8. 0	8 2. 8	73 .4	65.3	78.8
4	Oguta	55 .1	1 0 6 .2	7 4 .3 ± 8 .4	8 0 .9	6 6. 5	6 0. 5	7 3. 9	5 6. 4	10 7. 7	75. 4± 8.2	7 8. 4	6 8. 2	5 9. 4	7 4. 6	5 7. 3	10 1. 2	76. 4± 8.1	8 1. 7	6 8. 5	6 1. 3	7 5. 9	6 0. 5	10 2. 3	77 .1 ± 8. 1	8 2. 7	72 .3	64.5	78.8
5	Uga	56 .3	1 0 1 .4	7 3 .8 ± 8 .7	7 8 .2	6 7. 4	5 9. 6	7 3. 5	5 6. 6	99 .4	73. 8± 8.8	7 9. 8	6 7. 6	5 9. 4	7 5. 0	5 9. 4	10 6. 4	76. 4± 8.9	8 1. 9	6 8. 3	6 2. 6	7 4. 9	6 0. 5	10 9. 6	78 .7 ± 8. 6	8 3. 7	71 .2	64.5	77.7
6	Chisco	58 .3	1 0 1 .7	7 2 .5 ± 7 .4	7 9 .2	6 7. 0	6 0. 6	7 3. 1	5 7. 3	98 .5	75. 9± 6.7	7 9. 0	6 7. 3	5 9. 8	7 3. 8	5 7. 0	10 3. 6	75. 9± 7.6	7 9. 1	6 9. 3	6 1. 5	7 4. 8	6 0. 8	10 6. 7	78 .4 ± 9. 1	8 2. 7	72 .4	63.9	78.9

7	RTC	55 .4	1 0 6 .6	7 3 .8 ± 8 .5	7 9 .0	6 6. 3	5 9. 8	7 2. 8	5 6. 5	10 8. 4	73. 9± 8.1	7 7. 7	6 9. 5	6 1. 1	7 4. 4	5 7. 2	10 1. 6	75. 8± 7.2	7 8. 7	6 8. 4	6 2. 2	7 3. 2	6 0. 6	10 9. 9	77 .7 ± 7. 7	8 1. 7	71 .5	63.4	77.4
8	Peace Mass	57 .6	1 0 8 .2	7 4 .4 ± 7 .9	7 7. 3	6 7. 1	6 0. 8	7 2. 2	5 7. 2	10 6. 3	75. 1± 8.9	7 9. 7	6 6. 4	6 0. 6	7 2. 9	5 6. 4	99 .3	76. 0± 8.7	8 0. 4	6 8. 4	6 0. 4	7 5. 5	5 9. 7	10 8. 7	76 .9 ± 9. 7	8 0. 8	73 .6	62.6	79.5
9	Fegge	54 .1	1 0 5 .2	7 5 .8 ± 8 .5	7 9 .3	6 8. 4	6 0. 4	7 4. 7	5 7. 5	10 5. 6	76. 8± 7.7	8 0. 4	6 8. 6	6 1. 6	7 4. 9	5 8. 6	10 6. 5	78. 5± 8.0	8 1. 4	6 8. 5	6 1. 7	7 5. 4	5 9. 7	10 7. 2	79 .1 ± 8. 7	8 2. 5	70 .3	63.4	76.8
10	Iweka	59 .5	1 0 5 .1	7 3 .4 ± 7 .1	7 9 .5	6 6. 5	6 1. 5	7 2. 2	5 8. 7	10 2. 6	75. 8± 8.2	7 8. 0	6 8. 6	6 2. 1	7 3. 1	5 7. 3	10 4. 9	76. 1± 7.7	7 9. 7	6 9. 6	6 2. 5	7 4. 8	6 2. 3	10 6. 1	78 .7 ± 8. 1	8 4. 7	72 .5	66.8	78.2

11	Obodo ukwu	55 .4	1 0 6 .2	7 4 7 .6 ± 7 .6	7 7 5	6 7 0 6	6 0 2 5	7 6 1	5 6	10 8 6	79. 5± 7.7	8 2 4	6 8 5	6 0 4	7 6 9	5 6 4	10 3 4	79. 5± 8.3	8 0 6	6 8 3	6 0 5	7 5 5	5 8 2	10 9 3	80 .2 ± 9. 0	8 2 4	70 .5	63.5	76.8
12	Modebe	56 .3	1 0 0 .8	7 5 9 .0 ± 8 .1	7 9 5 0	6 5 1 5	6 1 0 9	7 0 5 6	5 5 6	10 4 3	76. 7± 8.0	7 9 4	6 6 1 5	7 1 1 8	5 7 6	10 2 5	76. 7± 8.3	8 1 5	6 8 4	6 1 4	7 5 6	6 1 1	10 7 6	78 .8 ± 8. 0	8 2 1	71 .3	64.2	77.0	

Table 3: Noise descriptors (TNI, NPL, NC) variations at 12 different selected areas of Onitsha Metropolis at different time intervals

S/N	Name of selected area	8.00 am - 9.00 am			11.00 am - 12.00 pm			2.00 pm - 3.00 pm			5.00 pm - 6.00 pm		
		TNI	NPL	NC	TNI	NPL	NC	TNI	NPL	NC	TNI	NPL	NC
1	Ochanja	106	93.6	18.9	106.8	93.7	18.8	110.5	95.1	19.7	109.8	95.9	19.1
2	Relief	106.9	93.2	19.1	114.2	96.3	21.0	110.8	95.2	19.8	118.2	101.9	21.5
3	Upper Iweka	106	93.7	19.1	98	88.8	16.6	106.6	92.7	18.3	105.3	96.3	17.5
4	Oguta	112.1	94.3	20.4	105.4	93.6	19.0	112.9	96.3	20.4	107.3	96.4	18.2
5	Uga	104	92.1	18.6	111	95.4	20.4	109.8	94.2	19.3	111.3	96.9	19.2
6	Chisco	105	91.7	18.6	106.6	93.0	19.2	101.9	92.4	17.6	110.0	98	19.1
7	RTC	106.6	92	19.2	97.5	91	16.6	98.2	89.7	16.5	106.6	95.7	18.3
8	Peace Mass	100.9	90.5	17.7	107	92.0	19.1	110.4	95.5	20.0	105.4	97.7	18.2
9	Fegge	105.4	91.2	18.7	108.7	93.5	19.6	109.5	94.5	19.6	107.7	96.6	18.7
10	Iweka	103.5	90.3	18	95.7	89.0	15.9	101.3	92.0	17.2	108.4	96.1	17.9
11	Obodoukwu	107.8	89.3	16.8	117.2	98.6	21.7	110.9	95.6	20.1	109.1	95.7	18.9
12	Modebe	101.5	88.4	17.5	103.1	89.7	17.9	111.8	95.7	20.1	105.8	94.9	17.9

Table 4: Prediction of noise level of 12 different selected areas of Onitsha Metropolis

S/ N	Name of selected area	8.00 am - 9.00 am		11.00 am - 12.00 pm		2.00 pm - 3.00 pm		5.00 pm - 6.00 pm	
		Predicted noise level (L <sub>eq</sub> )	Actual noise level (L <sub>eq</sub> )	Predicted noise level (L <sub>eq</sub> )	Actual noise level (L <sub>eq</sub> )	Predicted noise level (L <sub>eq</sub> )	Actual noise level (L <sub>eq</sub> )	Predicted noise level (L <sub>eq</sub> )	Actual noise level (L <sub>eq</sub> )
1	Ochanja	74.7	76.4	74.9	76.8	75.4	78.5	76.8	79.1
2	Relief	74.1	76.7	75.3	78.3	75.4	78.4	80.4	79.6
3	Upper Iweka	74.6	74.3	72.2	74.5	74.4	77.2	78.8	77.6
4	Oguta	73.9	74.3	74.6	75.4	75.9	76.4	78.8	77.1
5	Uga	73.5	73.8	75.0	73.8	74.9	76.4	77.7	78.7
6	Chisco	73.1	72.5	73.8	75.9	74.8	75.9	78.9	78.4
7	RTC	72.8	73.8	74.4	73.9	73.2	75.8	77.4	77.7
8	Peace Mass	72.8	74.4	72.9	75.1	75.5	76.0	79.5	76.9
9	Fegge	74.7	75.8	74.9	76.8	75.4	78.5	76.8	79.1
10	Iweka	72.2	73.4	73.1	75.8	74.8	76.1	78.2	78.7
11	Obodoukwu	72.5	74.6	76.9	79.5	75.5	79.5	76.8	80.2
12	Modebe	70.9	75.0	71.8	76.7	75.6	76.7	77.0	78.8

Table 5: *Q (Traffic volume) and P (Truck – Traffic Mix Ratio) at 12 different selected areas of Onitsha metropolis at different time interval.*

S/N	Name of selected area	8.00 am - 9.00 am		11.00 am - 12.00 pm		2.00 pm - 3.00 pm		5.00 pm - 6.00 pm	
		Q	P (%)	Q	P (%)	Q	P (%)	Q	P (%)
1	Ochanja	625	1.01	480	2.68	497	1.54	860	1.59
2	Relief	568	1.11	488	2.69	495	1.28	571	2.25
3	Upper Iweka	524	1.84	472	2.67	501	1.79	417	2.43
4	Oguta	558	2.1	493	2.69	517	2.93	596	2.12
5	Uga	554	1.92	484	2.68	506	1.58	561	2.55
6	Chisco	540	1.36	457	2.66	496	1.28	657	2.23
7	RTC	553	1.02	445	2.65	491	0.95	672	2.43
8	Peace Mass	554	1.92	515	2.71	556	2.46	647	2.32
9	Fegge	531	1.94	501	2.70	523	1.78	532	1.91
10	Iweka	529	1.26	472	2.67	497	1.61	612	2.10
11	Obodoukwu	580	1.1	491	2.69	517	1.48	595	2.13
12	Modebe	582	1.83	476	2.68	492	1.08	607	1.98

Table 6: Total number of vehicles passing the road in unit time at 12 different times of a day in and around Onitsha Metropolis

S/ N	Name of selected area	8.00 am - 9.00 am				11.00 am - 12.00 pm				2.00 pm - 3.00 pm				5.00 pm - 6.00 pm			
		2 & 1 W	LMV	HMV	Tota l	2 & 1 W	LMV	HM V	Tota l	2 & 1 W	LM V	HMV	Tota l	2 & 1 W	LMV	HMV	Total
1	Ochanja	744	112	11	867	302	116	18	436	344	124	13	481	483	157	11	651
2	Relief	557	128	11	696	338	109	12	459	349	117	19	485	538	135	8	681
3	Upper Iweka	421	122	19	562	275	114	17	406	357	119	27	503	692	114	15	821
4	Oguta	512	127	15	654	343	117	11	471	403	118	10	531	613	137	13	763
5	Uga	511	119	12	642	322	109	21	452	370	124	24	518	794	146	18	958
6	Chisco	484	114	22	620	244	109	18	371	346	123	19	488	785	142	14	941
7	RTC	534	108	17	659	207	112	16	335	341	118	14	473	839	128	10	977
8	Peace Mass	496	134	12	642	407	106	12	525	513	114	11	683	761	135	15	911
9	Fegge	448	114	11	573	346	129	8	483	413	128	18	559	581	141	14	736
10	Iweka	446	121	8	575	277	115	14	406	349	118	14	481	562	136	18	716
11	Obodouk wu	396	126	12	534	335	120	11	466	396	132	10	538	402	146	8	556
12	Modebe	276	118	6	400	286	116	6	408	338	122	6	466	340	147	4	491

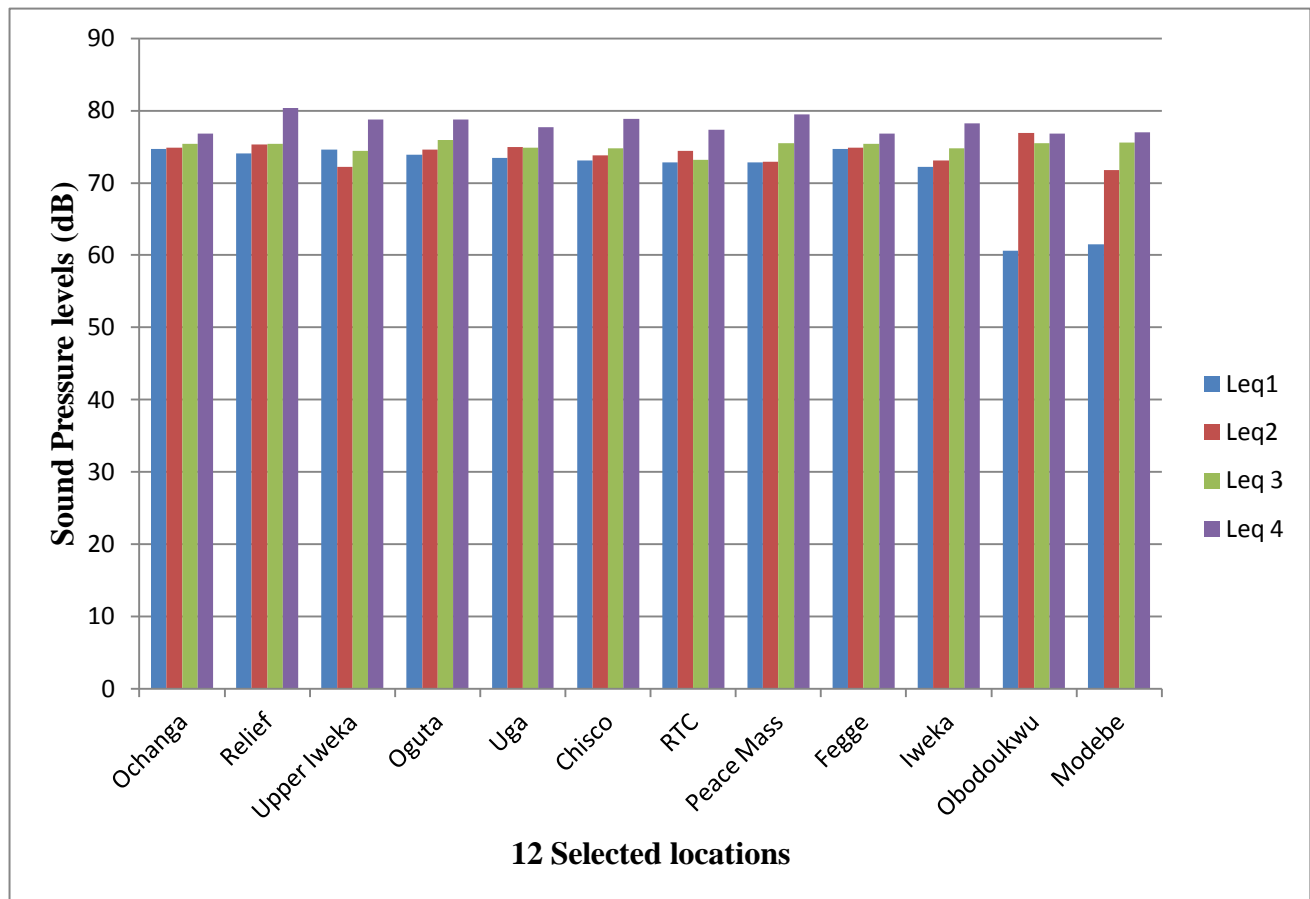


Figure 3: Sound pressure (dB) level against the 12 selected locations for four different times of the day

## DISCUSSION

The noise levels in all the location surveyed except at low residential areas are higher than the recommended level of 60 (A) for commercial areas and residential area (180:12 1996/1-1992 2004). The noise level is about 1-27 DB (A) above the recommended limit of 82dB (A) (Ramalingeswara and Rao, 1992) in all the locations surveyed except for the residential areas.

A graph of TNI, NC and NPL against four different times for the (12) different locations shows the average TNI range from(74.1 to80.4) dB (A) at commercial centers (72.2 to 78.8) dB (A) at road junction/ busy roads, (72.8 to 79.5) dB (A) at passenger loading parks (70.9 to 77.0) dB (A) at low- density residential area. Road junctions/busy roads and low- density residential area have the highest and lowest annoyance response due to traffic noise respectively. It should be noted that the world health organization recommends a noise level of less than 35 dB (A)

based on the continuous equal energy concept for the restorative process of sleep (Mufuruku, 1997).

## **NOISE MAP FOR ONITSHA METROPOLIS**

Noise maps describe spatial distributions of noise levels. They allow an efficient visualization of the noise distribution in area where the land uses are sensitive to noise. Noise mapping is a very efficient noise assessment method in urban area (Coelho and Alarcao, 2000b)

In this work, noise mapping and of course noise abatement plans drawn for noisy area (commercial centers, road junction/ busy roads, passenger loading parks, high density residential area) and low noise areas (low- density residential areas) are presented. All the data collected at the 12 selected areas were used to develop a noise map for Onitsha metropolis. A noise map based on LNP, NC, TNI has been developed. Figure 4 shows the noise map of Onitsha metropolis.

All these values of noise descriptors clearly showed high noise levels in Onitsha town mostly throughout the day in general and during the evening (5-6p.m) in particular. The calculated  $X^2$  values are 1.579; 3.763; 4.716 and 9.644 for different time intervals such as 8-9a.m., 11-12p.m., 2-3p.m., and 5-6p.m., respectively.

But  $X^2_{\text{tabulated}}$  at 90% level of significance at 11 degree of freedom = 3.05  
 $X^2_{\text{tabulated}}$  at 95% level of significance at 11 degrees of freedom = 4.57  
 $X^2_{\text{tabulated}}$  at 5% level of significance at 11 degrees of freedom = 19.67  
 $X^2_{\text{tabulated}}$  at 1% level of significance at 11 degrees of freedom = 24.72 Since our  $X^2$  value during 8a.m-9a.m. is too small than tabulated  $X^2$  value, therefore  $L_{\text{calculated}}$  and  $L_{\text{observed}}$  values are in good agreement at 11 degrees of freedom and at 90%, 95%, 5% and 1% significance level while the values during 11a.m. – 12p.m., 2p.m. – 3p.m. and 5p.m – 6p.m. are significant at 5% and 1% significance level.

Table 4 depicted the prediction of noise pollution levels at different selected areas of Onitsha by using the model of Griffiths and Langdon (Griffiths and Langdon, 1968). It is observed that the value of assessed predicted noise level is close to respective actual equivalent noise level measured. Such comparison depicted that the model used for prediction in the present study has the ability to calibrate the multi-component traffic noise and yield reliable results close to that by direct measurement. The correlation ( $R^2$ ) value for observed  $Leq$  versus calculated  $Leq$  for the present model is 0.281, - 0.08, 0.303 and - 0.285 for different time intervals of the afforesaid selected areas. Using the given data, a calibrated model has been checked for validation by  $R^2$  value and  $X^2$  test, which have given good results.

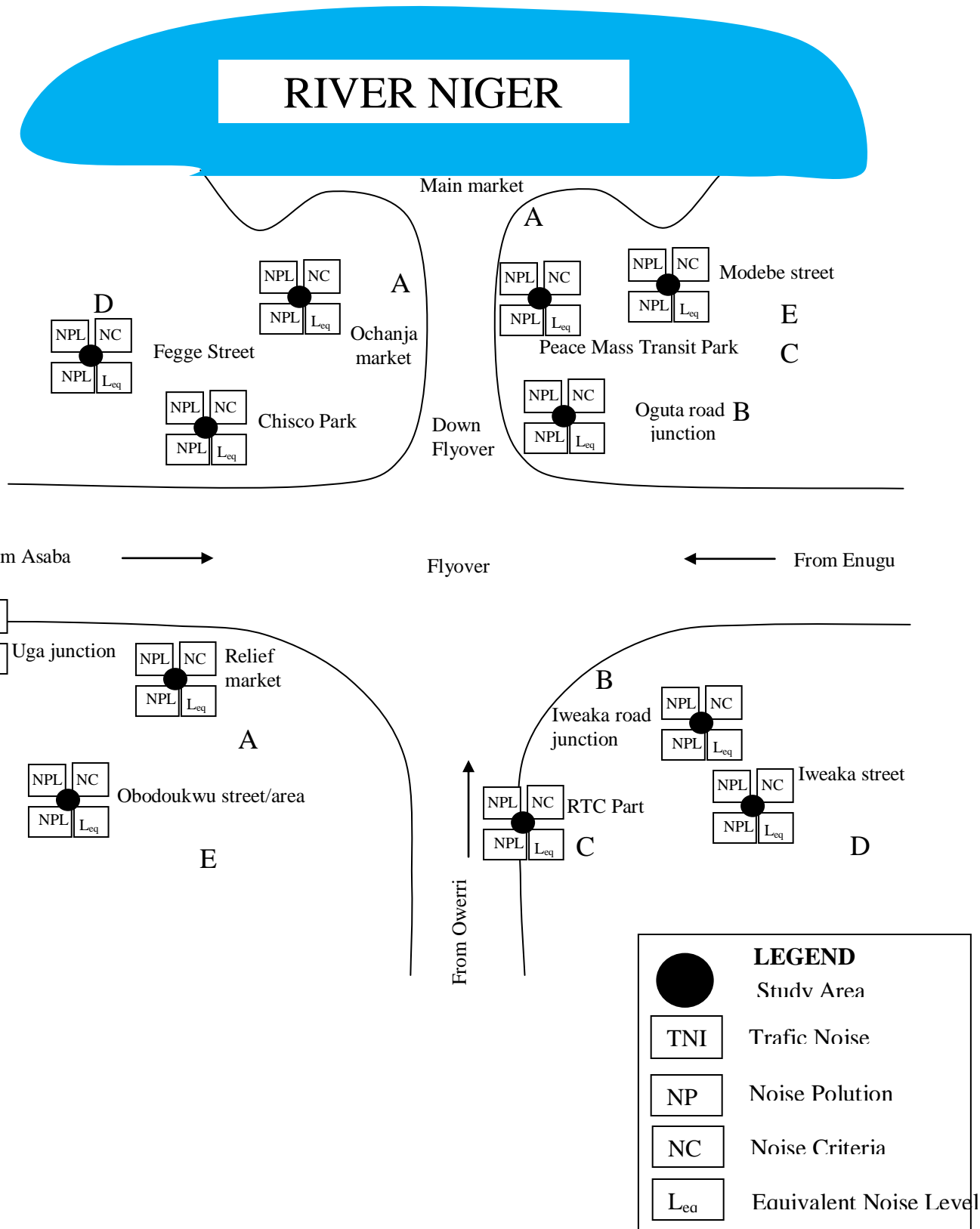


Figure 4: Noise map for Onitsha metropolis

The nucleus of the metropolis is characterized by a high noise exposure level. The noise pollution level is (88.4 to 101.9) dB, the NC is (17.7 to 21.7) dB and the TNI is (97.5 to 118.2) dB. The RTC, Chisco, Iweka junction and street, Fegge Street, relief market all comprise the nucleus of the metropolis as they are close to a flyover. At the centre of the metropolis, there are concentration of shops, markets, and clustered buildings with high population and traffic volume. All these are responsible for high noise exposure level; therefore, the residents living or trading in these areas are exposed to noise levels of 80-90 dB (A) or more every day. This is very dangerous to the health of the people in these areas. According to the World Health Organization (WHO), 60dB (A) sounds can result in temporary hearing impairment and 100 dB (A) sound can cause permanent impairment (Kiely, 1998).

The noise level at Onitsha metropolis is similar to those reported for other cities around the world in Jordan, Spain, Brazil, Greece, and India (Ahmed *et al.*, 2006, Amando and Jose 1998, Zannin *et al.*, 2002, Georgiadon *et al.*, 2004; Panadya, 2003).

This work reveals the importance of noise map for Nigeria urban areas as it enables one to know areas that are noisy and ones with low noise. Also the category of people in the urban areas exposed to different noise sources and noise exposure dose, based on their occupation, is known with the help of the noise map. Furthermore, the noise map has the potential to enable data to be accessible to the general public in a way that is comprehensible. This could have the effect of raising people awareness of noise as a pollutant and, thus creating the climate necessary for the implementation of noise -reduction programs.

## **CONCLUSION**

This study was carried out to measure the noise levels in Onitsha metropolis. The focus was on five selected areas of twelve locations: commercial centers, road junctions/busy roads, passengers loading parks, high-density residential areas, and low -density residential areas.

The measure reveals that noise levels at 10 of 12 selected areas exceeded the recommended limit of 82dB(A) by values of 1-27 dB(A). Hence the present value of noise pollution in Onitsha metropolis poses a severe health risk to the residents. Furthermore, discomfort and irritation being caused by the pollution can drastically reduce productivity, both in public service and private sectors. In addition some areas may soon reach the threshold of pains and lead to permanent loss of hearing and death.

Due to these possible adverse effects of noise pollution on the populace, a number of action plans can be taken to abate the environmental noise pollution in Nigeria. These include technical, planning, behavioural and educational solutions. Since

transport infrastructure can be recognized as major sources of noise, technical actions on the transport systems can produce interesting results.

Possible technical controls include changes in road profiles; low -noise pavement (porous or porous elastic) types; effective repairs to the silencers and vehicle suspensions so as to reduce exhaust and rolling stock noise: reductions, limitations, or restrictions on traffic (types of vehicles, speed, hours of access, etc); and building of acoustic barriers along the sides of heavily travelled highways running through residential areas.

Transportation and land planning (private vs public transportation, bus lanes, parking areas, shuttle buses and pedestrian areas) are important components of the plan.

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# VIOLENCE AND SEX IN TELEVISION, VIDEO GAMES AND FILMS: IMAGES THAT SELL AND THE PLACE OF MEDIA LITERACY

Allen Nnanwuba Adum  
Nnamdi Azikiwe University, Awka,  
Anambra State, Nigeria  
Tel: +2348037585067  
E-mail: allenadum@gmail.com

Uchenna Patricia Ekwugha  
Nnamdi Azikiwe University, Awka,  
Anambra State, Nigeria  
Tel: +2348035962584  
E-mail: [ucheekwugha@yahoo.com](mailto:ucheekwugha@yahoo.com)

Ojinime Ebelechukwu Ojiakor  
Nnamdi Azikiwe University, Awka,  
Anambra State, Nigeria  
Tel: +2348162831637  
E-mail: [oojinime@yahoo.com](mailto:oojinime@yahoo.com)

Uche Victor Ebeze  
Nnamdi Azikiwe University, Awka,  
Anambra State, Nigeria  
Tel: +2348035838114  
E-mail: ucheebeze@yahoo.com

## ABSTRACT

*The media, no doubt has tremendous power in the area of socialization, cultivation and modeling of behaviour. The media is used for “escape” and withdrawal by the audience. The media has a world called media reality, whereas the audience lives in a real world called social reality. Media reality is replete with violence and sex, whether we talk about television, films or even video games. The question now is, why does media fare contain a high dosage of violence and sex? Who is served by these? Are they necessary? Are the audience fooled and influenced by these? Many times what people get from the media, for instance TV, is what they tend to believe. And if what they are fed is falsehood, one can imagine the level of harm that could be done. So, there is the need for people to understand the media and how to use media content. Against this backdrop, this paper gives a general overview of the vexed issues of violence and sex and the necessity of media literacy as a way of helping the media audience to sift the wheat from the chaff.*

**Keywords:** Violence, sex, media literacy, video games, images that sell

## INTRODUCTION

The range of the media to which the audience, especially the youth and children have access to have grown rapidly in recent times. Constant exposure to films, television and video games, for instance, make for a dense electronic bath in which children and youths are daily immersed. This situation appears to be true not only in advanced countries but increasingly in all the societies of the world. The questions that might be asked are: what impact do images of violence and sex in the media have on the audience, especially youths and children? What can we do about it? How do we strike a balance between freedom of expression and the protection of our children and youth?

## THE ISSUE OF TELEVISION VIOLENCE

The audio-visual quality of television makes it one of the most potent communicative forces in the world (Okunna, 1999). Many times what people see on TV is what they are most likely going to believe. The idea of media reality is mostly fostered by television and to some extent films or home videos. According to Gerbner (1994), heavy exposure to television imparts a worldview that is consistent with the "world" of television. Furthermore, Gerbner (1994:40) holds that "People think of television as programmes, but television is more than that; television is a mythology - highly organically connected, repeated every day so that the themes that run through all programming and news have the effect of cultivating conceptions of reality."

Violence on television is just one of the areas that cause a distorted concept of reality. "Television violence" usually refers to *all* the violence appearing on TV screens. It includes material broadcast over the air, distributed by cable and satellite systems, and available on video plates and Mp4s. George Gerbner describes violence as "the act of injuring or killing someone or the threat of injuring or killing someone." The National Television Violence Study (1996), funded by the National Cable Television Association in the U.S. defines violence on television in broader terms as "any overt depiction of the use of physical force – or the credible threat of such force – intended to physically harm an animate being or group of beings." The UCLA Television Violence Monitoring Project (1995), commissioned by four major American networks (ABC, CBS, Fox, and NBC), defined violence as anything that involves physical harm or a threat of physical harm of any sort, intentional or unintentional, self-inflicted or inflicted by someone or something else. Given that there are many types of television violence, arriving at a standard definition that is comprehensive, yet succinct and unambiguous, could be a daunting task. A common understanding or definition of what constitutes "television violence" could be useful in helping to examine and regulate the problem.

Most of the violence we have on television is what Gerbner calls "happy violence." It's swift, it's thrilling, it's cool, it's effective, it's painless, and it always leads to a happy ending. The effects of violence on television should and indeed has been a cause of concern for many media analysts. The effects of violent TV content on children should be of special concern because youngsters have trouble distinguishing between the real world and the world of the small screen. Cartoons for instance seem to be the most culpable in de-sensitizing children to violence. Preschoolers overwhelmingly prefer and pay close attention to cartoons –a format that is particularly violent (Kodaira, 1992). To the child's mind if Tom gives Jerry a bash on the head and he recovers instantly, then the same should be true for little sister. For children who spend a great deal of time with television, unsupervised by their parents, there exists the potential for great harm to their impressionable minds. This amounts to what Gerbner (1994) calls "mean world syndrome", a situation where viewers especially children, exposed to more hours of television, tend to live, for all practical purposes, in a meaner world, and act accordingly, than the next-door neighbour who lives in the same world but watches less television.

This mean world syndrome results in a reduced sensitivity to the consequences of violence. Growing up from infancy with this unprecedented diet of violence has three consequences. A more pervasive effect is that television de-sensitizes viewers to victimization and suffering; they lose the ability to understand the consequence of violence; to empathize; to resist; to protest.

Watching violent content contributes to adolescents' sense of the world as a mean place (Cantor and Reilly, 1982.). Adolescents who watch only a little television appear to feel much less vulnerable to crime than do young adults who watch (Potter and Chang, 1990). However, it appears that adolescents who do not consider the televised violence to be real will not see the world as a mean and scary place or feel an exaggerated sense of personal vulnerability to crime from watching violent or other scary content on television (Potter, 1986). In addition, adolescents who have been victims of crime or who know someone who has been a victim tend not to rely on television as their source of information about the likelihood of being victimized. (Slater and Elliott, 1982)

In order to help address the issue of the impact of violence in the media, UNESCO conducted a global media survey on media violence in 1996 and 1997. More than 5,000 12 year-olds in 93 countries were involved, representing all regions of the world and a whole gamut of cultural and economic conditions. The study found evidence that media images reinforce the experiences of children in their real-life environments. Almost half (44%) of both boys and girls reported a strong overlap between what they perceive as reality and what they see on the screen.

Many children experience both real and media environments in which violence appears to be natural and the most effective solution to life's problems. Where violence is not a feature of daily life, media portrayals may make it appear to be thrilling, especially when presented out of context.

## **VIOLENT VIDEO GAMES IMAGERY**

Although there seems to be the tendency to evaluate video games more positively than television, there appears to be a sufficient similarity between television violence and video-game violence to warrant the belief that children and adolescents who are mostly exposed to video games could become increasingly aggressive (Sneed and Runco, 1992). In fact, one would expect children to become more aggressive from playing video games than from watching television because in playing video games, children are rewarded for being symbolically aggressive.

Some studies have revealed that children who play with toy weapons or play a competitive game become as aggressive as children who have been exposed to television violence (Huston and Wright, 1989). Though evidence as to the negative effects of violent video games appears sparse, there are reasons to believe that they could be harmful in the area of inducing aggressive behaviour among children and adolescents.

## **VIOLENT FILM IMAGERY**

The possibility of films having a negative effect has been a source of great concern to communication scholars over the years. Although films appeal to people of all ages, they seem to appeal more to adolescents and young adults, who are deemed particularly vulnerable to media influences (Hanson, 2005). According to Kenny (1999; 86), "film is by and large a popular (and terribly expensive) art, the vast majority of moviemakers want to give the audience the pictures they think the audience wants to see, or the pictures that preview cards and focus groups tell moviemakers the audience wants to see" This view suggests that violence on film might reflect the yearnings of the society. How true is this? This is subject to debate. But one thing is clear; films are an immensely powerful social and cultural force. They can produce social changes – in ways of dress, patterns of speech, and methods of courting; they have mirrored social changes – in fashion, sexual mores, political principles etc.

## **MEDIA DEPICTION OF SEX**

Sex in the media could be traced back to the Hollywood scandals of the 1920s in the U.S. Media representation of sex raises some moral questions. This is a serious problem because failing to discuss issues related to sexuality and its depiction in media may be a contributing factor to the growing decadence in the society like teen pregnancies the spread of AIDS and other sexually transmitted diseases and even sexual violence against women and children of both genders Those members of the media audience, especially youths and children, who are exposed to some sort of pornography have their attitudes and personalities shaped by the images to which they are exposed.

## **THE BUSINESS OF MEDIA VIOLENCE AND SEX: IMAGES THAT SELL**

Why are we awash in such a tidal wave of violent imagery despite the fact that right thinking people are opposed to violent programming?

Violence appears a staple of both television and movies. The reason is that violent programs travel well on the global market. Since there are only a few buyers of television programmes, American producers, for instance, can't break even on the domestic market, so they are forced onto the world market to make a profit. When you are forced onto the world market you are looking for a formula that will travel well, that needs no translation, and speaks action in any language.

So many of the stereotypes and violent images are the result of the imposition of a *de facto* censorship in the form of the marketing formulas that are imposed on the creative people who write, produce, direct, and act in them.

Violent Images are also foisted on children of the world; no country likes it, it doesn't serve any of their needs, but it is driven by the existing system of global marketing.

In the aftermath of the shoot-out tragedies in U.S. High Schools, a broad national debate was developed to intervene in the American "culture of violence." Many had fingered inadequate parenting; the availability of guns; alienation of youth; mental illness, school security, manipulative violence in film, video games, television, the Internet and pop music as the major bases for such incidents. Even television news is part of this toxic stew. More than being society's mirror of reality, the electronic communication media collect and concentrate the planet's woes and deliver them into people's living rooms each night. The audiences of American CNN who watch TV news regularly are subjected to a substantial dose of catastrophe. And, in such news, the scenes are real not make-believe.

It does appear that media practitioners know that their broadcast images have enormous power and must be handled with sensitivity. Yet, the news industry does not seem to have ethical guidelines for violent programming.

Events portrayed on television news apparently generate copycat crimes, including mass murder, terrorism, hijackings, workplace violence, product tampering, hate crimes and suicide. This is what Osama Bin Laden's videos, aired on Al Jazeera Arab satellite TV, did to radical Islamists. Numerous research studies over the last three decades have reported that viewing violent video inspires violent resolution of conflict, encourages aggressive behavior and diminishes empathy for victims.

TV sells what it shows – stupefying discovery or stupefying mayhem. By repetition, gruesome and gory images are burned into peoples' brains just like images of heavily advertised products. Television's power to influence behavior and belief attracts billions of advertising dollars yearly. Cultural habits and values are also

susceptible to television's influence and TV news images can inspire wars, stop wars, elect or topple leaders.

Some might insist that media violence is harmless entertainment, escapist fare or cathartic diversion, or that people have a "taste for violence." Others, desensitized by hundreds of thousands of acts of violence they have seen on TV, might deny the problem, but it is still a problem anyway. Media moguls might resent any idea of regulating their bread-and-butter fare of violence or reject the evidence of its harmful effects but it is rather too obvious that violent broadcast programming, if left unchecked, can do a lot of disservice to the society.

The same goes for the depiction of sex in the media. People are moved by sex appeals no doubt. That is why you can hardly see any advert where sex appeal is not used. In the movies even where you have documentaries or war films provisions are always made for bed scenes, even when such scenes are out of sync with the whole story line. Think about *Titanic*. Was the sinking of the ship all about love and romance? Think about *Pearl Harbour* or *Berlin Air Lift* were these films all about love? But they had lurid sex scenes. Why? That is what sells!

## **MEDIA LITERACY EDUCATION**

Media literacy is the ability to understand and make productive use of the media in our lives (Rodman, 2006); it is the ability to make sense of media content. Since the media claims to reflect society, media literacy helps the media audience to sift the wheat from the chaff in the sense of judging how really the media reflects the society. Media literacy among children would make them understand that cartoons are mere fantasy. This to a great extent affects the way their behaviour is influenced.

It is very easy to consume media content. At the push of a button, we have television pictures or film scenes, but media literate consumption, however, requires some specific skills. According to Baran (2002: 50), these skills are as follows:

- ❖ The ability and willingness to make an effort to understand content, to pay attention, and to filter out noise.
- ❖ An understanding of and respect for the power of media messages
- ❖ The ability to distinguish emotional from reasoned reactions when responding to content and to act accordingly
- ❖ Development of heightened expectations of media content
- ❖ Knowledge of genre conventions and the ability to recognize when they are being mixed.
- ❖ The ability to think critically about media messages, no matter how credible their sources.
- ❖ Knowledge of the internal language of various media and the ability to understand its effects, no matter how complex.

Media literate individuals are better able to decipher the complex messages they receive from television, films and video games. Media literacy skills can help one understand not only the surface content of media messages but the deeper and often more important meanings beneath the surface. Media literacy education seeks to give media consumers' greater freedom by teaching them to analyze, access, evaluate, and produce media. Once kids learn how to see through the surface of today's media, to understand how and why they're being manipulated, they become more critical consumers of media, more receptive to other ideas and information, and better able to tell their own stories with modern media. A media literate child can be, a healthier child. It is particularly important to use media literacy skills to analyze advertising messages. The hunt for consumer naira is on, and teens are a prime target. Think about *Big Brother Nigeria* reality TV show!

The world of the adolescent cannot be understood without considering the profound influence of the mass media, especially television; but also movies and video games in shaping young people's attitudes and values about acceptable behavior, their perceptions of what kind of society they live in, their place in society, and their expectations of the future. Every day, we're bombarded with information and images from a wide variety of media, including television, radio, newspapers, magazines, books, and the Internet. If information were knowledge, we'd all be geniuses. Developing healthy evaluators, not just passive consumers of mass media therefore becomes a necessity. Herein lies the place of media literacy.

## **RECOMENDATIONS**

Violence attracts people's attention and produces a strong emotional reaction that advertisers covet. Violence, talk of violence and threat of violence are the most effective tools for manipulating people – propagandists from Machiavelli to Mao have known this. Like an addictive drug, we have been subjected to ever increasing doses of more and more graphic violence over the last few decades. What can be done?

First the dosage of news violence should be lowered and, explanation adduced for showing cruelty on television and films. In real life, violence has consequences. Balanced news includes a balance of topics.

Second, media practitioners need to be educated about their potentials to do harm and the media industry should develop ethical standards for dealing with potentially hazardous material.

Third, broadcast media organizations should be required to infuse warning labels directly on television broadcasts in the form of prime-time public service announcements that explain and alert viewers to harmful TV effects.

Fourth, technological controls could be put in place to help parents become better programming gatekeepers. Such controls include devices that allow individual

programs to be filtered out, entire channels to be blocked, or TV sets and remote controls to be locked, barring young children from turning on equipment by themselves.

Fifth, public awareness and education initiatives towards achieving media literacy should be put in place to help viewers make informed and responsible choices about the types of television programs they, or those in their charge, watch.

## **CONCLUSION**

The youth is usually associated with the culture of violence and, constant exposure to violent TV programming, seems to engender youth de-sensitization towards violence

There are certain things that parents can do to influence the effect that television content has on their children. However, an entertainment medium that purports to meet the needs of the Nigerian public should not be so saturated with potentially harmful content that parents are considered negligent if they don't constantly monitor their children's watching. Children whose parents have the motivation and resources to be vigilant and active mediators will likely avoid most of the negative effects of violent content. But not all parents will do that, and, in fact, the children who are otherwise the most vulnerable to the effects of television violence may be the ones whose parents are least likely to be vigilant mediators (for example, abusive parents and parents of families in distress).

It is certainly true that television violence does not account for all the causes of children's aggression, and it is also true that some children are a great deal more likely to be affected by television violence than others, and that it is these children who are likely to be potentially more aggressive anyway. But the effect of television violence leads these "at-risk" children to be even more aggressive than they would otherwise be. And although the group especially at risk might be a minority of viewers, they are likely to be the majority of aggressors. This fact makes them, and the violent content of television, worthy of attention.

By and large, the aim of media literacy education is to make people active and critical thinkers in relation to the media surrounding their daily lives. This is the only way a young individual can grow up to be informed and active in consuming media content.

Children educated to analyze media content learn to recognize the contradiction between their taste for violence on television and their rejection of it in real life. Media education also allows children to become active producers of media content, to learn methods and language of the media, and to use it in a healthy way as a vehicle for their own self-expression ([Http://www.media-awareness.ca/](http://www.media-awareness.ca/)).

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# IMPLEMENTATION OF E-LEARNING FOR CHARACTER AND SKILL DEVELOPMENT IN NIGERIAN COLLEGES OF EDUCATION: ISSUES AND CHALLENGES

Ezeoba, Kate O., Ph.D.  
Department of Curriculum and Instruction,  
Nwafor Orizu College of Education,  
Nsugbe, Anambra State. Nigeria  
Email: [ezeobakate@yahoo.com](mailto:ezeobakate@yahoo.com)  
Tel: 08034907522

Okafor, Victor Emeka, Ph.D.  
Department of Social Studies,  
Nwafor Orizu College of Education,  
Nsugbe, Anambra State. Nigeria  
Email: [victorokafor22@gmail.com](mailto:victorokafor22@gmail.com)  
Tel: 08063871810

## Abstract

*The 21<sup>st</sup> century teacher is expected to be an expert in the use of e-learning facilities in enhancing their students' acquisition of knowledge. This paper examines the concept of e-learning as an instrument for character and skill development. It highlighted and explained various e-learning facilities such as the internet, teleconferencing, audio-conferencing, videoconferencing, electronic mail among others as facilitators for effective teaching and learning. The strategies of implementing e-learning in Nigeria colleges and challenges militating against the effective use of e-learning were sequentially explained. The paper concluded that the integration of e-learning into the teacher training programmes and provision of adequate e-learning facilities will enable the teacher play effective roles in the development of the character and skills of the learner.*

**Keywords:** E-learning, skill development, videoconferencing, teleconferencing, audio-conferencing

## **INTRODUCTION**

E-learning has made a great impact in all facets of education including teacher education. It has revolutionized education by making all important information available to the learners. The fundamental difference between today and future is that information will be created, stored and transmitted in digital forms. E-learning facilities such as CD-Roms or DVD, video or audio-cassettes, e-mailing, teleconferencing, web-conferencing, videoconferencing, mobile learning. Internet learning have contributed tremendously to character and skill development of learners. Learners who have access to e-learning facilities are more versatile and knowledgeable.

For teachers to be relevant in this new information and technology age, teacher education must adopt e-learning programme in their training. The implementation of e-learning in the teachers' training institutions will not only position the teachers to be more effective and efficient but to remain relevant in the current trends of technologies application in education globally.

The e-learning facilities are still lacking in some colleges of education. But it is important to note that people see technology as a luxury rather than a means of survival (Nwafor, 2007). In some schools, no effort is being made to procure these modern technologies and even where there are trends of reform, the rate is too slow. Sulaiman (2008) observed that the use of e-learning facilities for instruction purposes is not only the provision of such facilities but to integrate the use in every subject area in the school curriculum.

## **THE CONCEPT OF E-LEARNING**

The world of today is driven by information, knowledge and technology. If people will be relevant in this new dispensation, there must be the readiness to contribute significantly to the new world order of information technology (Abimbade, 2006). E-learning is the use of information and communication technologies (ICTs) such as internet, digital technologies e.t.c. to create and deliver experiences that educate our fellow human beings. It primarily facilitate teaching, learning and training.

## **E-LEARNING: INSTRUMENT FOR CHARACTER AND SKILL DEVELOPMENT**

According to Osaat and Oyet (2012), the application of e-learning in teacher education programme makes for an effective and efficient teacher in these following ways:

- E-learning helps learners to acquire specific skills. In this case, it can assist students learn mathematics and other subjects without difficulty.
- The classroom teacher uses e-learning for grade reporting. It saves time and helps him provide reports of students grades. It is used in test, quizzes, and work sheets.
- It is useful for teachers to grade and store grades, achievement test scores, parents contacts and other information.
- Assignment would be easier to control with e-learning.
- A great deal of manual work will be eliminated and instantaneous information on the students progress would be retrieved from operating system when necessary.
- E-learning enables the teacher reach a great number of the students online. It saves the teacher from problem of space for learning.
- The students can obtain information necessary for his/her studies and be able to interact with his/her teacher anywhere in the world.

### **E-learning Facilities Relevant for Skill and Character Development in Teacher Education programme**

- The Internet: It is a computer network used for worldwide communications. Onuigbo (2003:1) affirms that "what makes the internet unique as a global network is its worldwide collection of digital telecommunication links that share a common set of computer- network technologies, protocols and applications". The internet is a veritable resource for learning. Teachers and students get current information on different school subjects. Some universities offer online programmes which enable a person to register and learn online. This is electronic learning (e-learning) and it is a great boost to distance education. Besides, the internet makes available electronic books (e-books) which are electronic forms of complete text textbooks.
- Teleconferencing: It is a conference that is usually arranged by connecting individuals or groups who are geographically separated. These geographically separated people are connected through the public telephones system, especially using either the audio links only, or the audio links in addition to the television pictures. When only the audio links are used, the device is called audio teleconferencing. But when the audio links are used in addition to the television pictures, the device is referred to as conferencing.
- Audio conferencing: This process represents a live, two-way conversation among groups at different locations connected by telephone lines or satellites. It requires a special micro phone with amplifier device (Heinich, Molenda and Russel, 1993). It is extensively used for propagating distance education as well as for students tutorials.
- Video conferencing: This is an online meeting that could be holding between two or more participants. It is two-way exchange of both live television images and audio signals between two or more sites and three or more individuals. In this videoconferencing, such facilities as these are used. They

include computer or network with appropriate software, video cameras, microphone and speakers as well as telephone lines or other cabling to transmit audio and video signals (Roblyer, 2003). In Nigeria, videoconferencing is now widely used but not for educational purposes. It is extensively used for discussing contemporary issues in the areas of politics, economy, security and other national and international problems. Through video conferencing, teaching and learning take place in real and meaningful contexts (Norman, 1997).

- *Electronic Mail (E-mail)*: Electronic mail is a general term that is used to refer to a system that enables letters, messages etc to be sent from one individual, department, institution etc to another solely by electronic means, without the use of a conventional postage on internal mail system. E-mail allows a meaningful interaction between the teacher and the learner; it promotes educational programmes like E-learning, E-tutoring and E-schooling (Iwu, 2004).
- *World Wide Web (WWW)*: The web is not synonymous with the internet but it is one way to utilize the infrastructure of the internet. This is information website with w.w.w learners have access to an unprecedented amount of authentic information, as well as the possibilities to publish and distribute their own multimedia information for other users consumption (Robinson, 1994 and Iwu, 2004).

## **STRATEGIES OF IMPLEMENTING E-LEARNING IN NIGERIA COLLEGE OF EDUCATION**

Based on the importance of E-learning in educational advancement, the following strategies should be adopted in implementing it in Nigerian schools:

- The government in conjunction with tertiary institutions that train the teachers should work to change the course programme of the trainee teachers to include E-learning courses.
- Federal and state government should as a matter of urgency employ qualified E-learning personnel into the tertiary institutions to help in training the teachers.
- The government and cooperate institutions should provide E-learning facilities to the tertiary institutions and other levels of our education system so that the students can access these facilities.
- A monitoring team should be set up to help in checking how teachers use these facilities in teaching their students.
- Regular training should be organized for teachers on the use of E-learning facilities to better their teaching skills.

The Challenges Militating Against the Effective Use of E-learning include the following:

- *Infrastructural Deficiencies*: Many developing countries like Nigeria do not manufacture/produce hardware and software needed for information technology services. In some countries, there is still the problem of steady power supply. For effective and efficient management and running of the information technology services, these problems have to be tackled.
- *Globalization and Neo-colonialism*: More access may result in the danger of certain countries dominating the educational scene of countries with lesser resources. The developing countries may lose their initiatives and self identity, this fear may make the whole concept of globalization another form of neo-colonialism.
- *It does not Appeal to all Learning Styles*: E-learning does not appeal to all learning styles, as a result, some learners will not enjoy the experience. Some may prefer images, some prefer just reading words, while some will prefer doing a task in order to learn.
- *Problem of Technological Devices*: With heavy reliance on computers, there is need to ensure that all learners have technological devices that are able to support the training modules. Some e-learning tools require software such as flash while some may require devices like ipads. So all requirements need to be set out at the beginning of the training.
- *Problem of Qualified Personnel to Impart E-learning Skills*: Some instructors or teachers lack the technical knowhow on the working of e-learning facilities. The very idea of using e-learning facilities is demotivating for some instructors because they lack the basic skills of manipulating these facilities.

## CONCLUSION

The training of our teachers should consider both theoretical and practical approaches and there should be an effective integration of E-learning courses into the teacher training programmes; availability of personnel in the tertiary institutions to undertake this and the provision of adequate e-learning facilities. The teacher can only play his expected roles of character and skill development effectively and efficiently in this age of information technology with adequate knowledge of e-learning and available facilities.

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# DESIGNING AN AUTOMATED CODE GENERATOR FOR MULTI-AGENT BASED PROCESS CONTROL AND MONITORING

Hight C. Inyiama, Ph.D.

Department of Electronic and Computer Engineering.  
Nnamdi Azikiwe University, Awka.  
Anambra state, Nigeria.  
[hcinyiama@gmail.com](mailto:hcinyiama@gmail.com),  
+234-8034701121

Ifeyinwa C. Obiora-Dimson, Ph.D.

Department of Electronic and Computer Engineering.  
Nnamdi Azikiwe University, Awka.  
Anambra state, Nigeria.  
[ifeyinwa29@yahoo.com](mailto:ifeyinwa29@yahoo.com)  
+234-8032638315

Christiana C. Okezie

Department of Electronic and Computer Engineering.  
Nnamdi Azikiwe University, Awka.  
Anambra state, Nigeria.  
[christianaobioma@yahoo.com](mailto:christianaobioma@yahoo.com)

## Abstract

*Five classes of intelligent agents namely one class of process control agent and four classes of state control agents have been identified as being sufficient for use in the implementation of any process control system which can be represented as an Algorithmic State Machine (ASM) chart. One class of process monitoring agent and four classes of state monitor agents have also been identified as being sufficient for the monitoring of any process control system that can be represented in the form of an ASM chart. These two sets of five intelligent agents form the basis for automated code generation for process control and monitoring because their codes are object-oriented and reusable. A new process control software can be fully specified simply by using agents which are instantiations of the agents control classes. Similarly, any monitoring software can be formulated by using agents which are instantiations of the agent monitoring classes. Both control and monitoring agents can be automatically created after prompting the user for values derived from the ASM chart representing the process control system. Such values are easily discernible when the ASM chart is converted into the corresponding fully expanded STT. If needed, these values can be taken from a pre-stored database table by the automatic code generator. When both the process control software and the process monitoring software can be automatically generated, the platform that offers this facility becomes unique to any process control system developer interested in automatic code generation.*

**Keywords:** Automatic code generator, process control agent, state control agent, process monitoring agent, state monitoring agent

## INTRODUCTION

The use of multi-agents has facilitated the level of complexity encountered in industrial automation (Aguilar, Cerrada, Hidrobo, Rivas, Cemisid, 2006; Akpado, Inyama, Okezie, 2010). Multi-agents have improved on the use of objects because of many characteristics inherent in agents such as proactivity, autonomy, co-ordination, e.t.c. (DeLoach, Wood and Sparkman, 2001). The multi-agent system envisaged here interacts together to perform the function of control and remote monitoring in the environment of digital systems. With automatic code generation, a new process control system can be automated to perform its function by simply applying the codes that shall be developed here to this new system. By supplying the relevant input codes that would initialize this new system, the pre-stored table with the information to handle the function is automatically generated and executed making the system function in its capacity. This automatic code generator is aimed at reducing software design effort from scratch when the need to design a new multi-agent based control and monitoring system arises. In this paper, agent types and classification with respect to this design method shall be discussed and an industrial control and monitoring example shall be used to showcase the code generator multi-agent based design method envisaged in this paper. The platforms developed by Inyama, Okezie, Okafo, (2012), for process control design using multi-agents and that developed by Obiora-Dimson, Inyama, Okezie, (2013), on remote process monitoring using multi-agents are primary in this paper.

## AGENTS AND CLASSIFICATION

In this work, these five agent classes were recommended namely classes 0 through 3 and a process agent control class, for use in the implementation of any process control which can be represented as an Algorithmic State Machine (ASM) chart (Inyama et al 2012). An agent of class 0 makes a transition from its present state to another state without considering any qualifiers (Fig. 1A). This happens typically where two state boxes in an ASM chart are in sequence without any qualifier in between them. As shown in figure 1A, if the control system is in the state STX it must unconditionally transit to state STY when a clock pulse occurs.

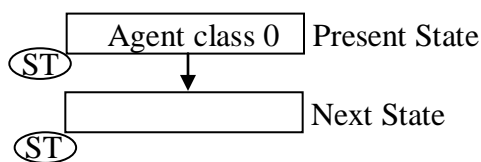


Fig 1A: Agent Class 0

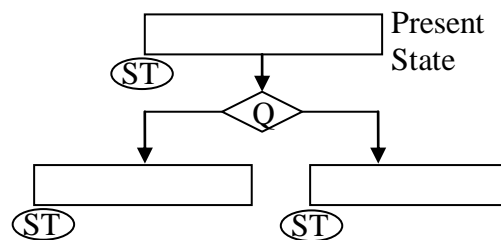


Fig 1B: Agent Class 1

State agent class 1 is one that handles transition from one state (STX say) to one of two alternative states (STY and STZ) depending on the value of the qualifier (Q say). This is shown in Fig. 1B. If the control system is in STX and the qualifier  $Q=0$ , control is transferred to the agent state for STY. However, if qualifier  $Q=1$ , control is transferred to the agent for state STZ.

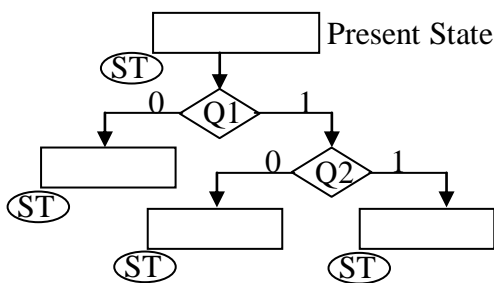


Fig 1C: Agent Class 2

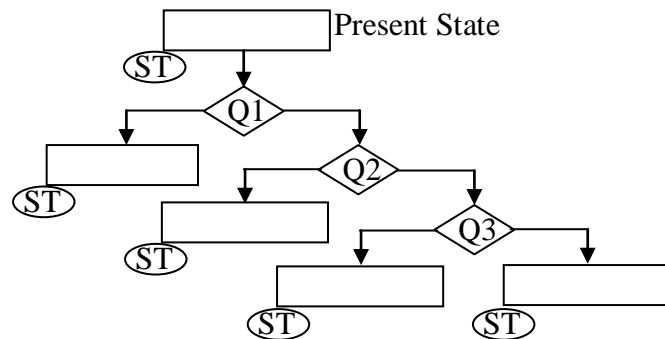


Fig 1D: Agent Class 3

State 2 agent has two qualifiers in cascade and the agent in the present state has four alternative link paths that determine the next state agent to handover to. Each of the link paths may be selected depending on the values of the qualifiers  $Q_1$  or  $Q_2$  say. For example, if the present state is named  $ST_0$ , the state agent for  $ST_0$  would hand over to state  $ST_1$  if  $Q_1=0$ . It would still hand over to the state agent for  $ST_1$  whether qualifier  $Q_2$  is 0 or 1. Therefore qualifier  $Q_2$  is said to be a don't-care. If however,  $Q_1=1$  then control would be transferred to state agent  $ST_2$  if  $Q_2=0$  and to state agent  $ST_3$  if  $Q_2=1$ .

Agent class 3 is required for the condition where the present state is separated from the alternative states by up to 3 qualifiers in cascade ( $Q_1, Q_2, Q_3$ ) Fig. 1D. The transitions from the present state  $ST_0$  to each of the alternative states is determined by the three qualifiers  $Q_1, Q_2, Q_3$  as shown in table 1d. Note that when  $Q_1$  is a zero, transition must be to agent for state  $ST_1$  no matter what  $Q_2$  and  $Q_3$  are.

Similarly, when qualifier  $Q_1=1$  and  $Q_2=0$ , transition must be to state  $ST_2$  irrespective of the value of  $Q_3$ . The reason the fully expanded table is used is to facilitate the use of a look up table by the state agents which allows the indexing of the tables using qualifiers.

These transitions for agent class 0-3 are shown in table 1a, 1b, 1c, and 1d respectively.

Table 1a: Class 0 agent transition

Present state	Next state	Values
STx	STy	V0

Table 1b: Class 1 agent transition

Present state	Next state	Values
0	STy	V0
1	STz	V1

Table 1c: Class 2 agent transition

Q1	Q2	State agent that takes over	Values
0	0	state agent ST1	V0
0	1	state agent ST1	V1
1	0	state agent ST2	V2
1	1	state agent ST3	V3

Table 1d: Class 3 agent transition

Q1	Q2	Q3	Next state alternative	Values
0	0	0	ST1	V0
0	0	1	ST1	V1
0	1	0	ST1	V2
0	1	1	ST1	V3
1	0	0	ST2	V4
1	0	1	ST2	V5
1	1	0	ST3	V6
1	1	1	ST4	V7

Note that a don't-care combination translates to two entries in table 1, the case when the don't-care is a 0 and when the don't-care is a 1. However both transitions are from state ST0 to state ST1 because of the don't-care status of Q2.

In practice, the next state alternatives are replaced by their state codes shown at the top right hand corner of the ASM chart in which they occur rather than by their state names that occur at the bottom left hand corner. However the agents are named in table 1 for the convenience of the reader.

Although one could go on like this defining agent classes 4, 5, 6 and so on, the optimization technique developed in (Inyama et al 2012) allows one to limit the no of cascaded qualifier to at most 3

Finally, it must be borne in mind that a state agent is really an instantiation of a class. In agent oriented technology five classes are defined by the researcher namely classes 0 through 3 and a process agent class. When looking at an ASM chart, the state agents are made to be an instantiation of one of the agent classes depending on the number of qualifiers  $n$ , between it and alternative transition link paths (see Fig. 4). When  $n=0$ ,  $2^n = 2^0 = 1$ , only one next state exists and a value  $V_0$  is generated. When  $n=1$ ,  $2^n = 2^1 = 2$ , two possible next states exist and values  $V_0$  and  $V_1$  are generated. The logic value of the qualifier determines which is output. Actually the next state value selected is concatenated with the output bits to constitute the value output  $V_0$  or  $V_1$  etc; up to  $V_2^{n-1}$ . Where  $n = 2$ ,  $2^n = 2^2 = 4$ ;  $V_0$ ,

$V_1, V_2,$  and  $V_3$  are generated. If the two qualifiers are represented as  $q_1 q_2$ , then, when  $q_1 q_2 = 00$ ,  $V_0$  is output, when  $q_1 q_2 = 01$ ,  $V_1$  is output, when  $q_1 q_2 = 10$ ,  $V_2$  is output and  $q_1 q_2 = 11$  causes  $V_3$  to be output. A similar selection and output process is followed when there are 3 qualifiers  $q_1 q_2 q_3$  in between one state and another, in the case of type 3 state agents. Thus  $q_1 q_2 q_3$  would have 8 possible binary combinations namely 000, 001, 010, 011, 100, 101, 110 and 111 and would lead to the output of  $V_0$  or  $V_1$  or  $V_2$  or  $V_3$  up to  $V_7$  depending on the subscript  $s$  which  $V_s$  corresponds to.

## PROCESS AGENT

By nature, agents are autonomous among other attributes. Typically, the number of agents required to implement an ASM chart is equal to the number of states in that ASM chart Obiora-Dimson, Inyama, Okezie, (2013). To allow that number of agents to have full autonomy may cause a loss of control in the system especially if something goes wrong with one or more of the agents, hence the need for co-ordination (Terán, Aguilar, and Cerrada, 2014; Chen, Yang, He, and Goh, 2005). Therefore the researcher has introduced the concept of process agents, where a process agent co-ordinates the activities of all the state agents in the same ASM chart as depicted in figure 2.

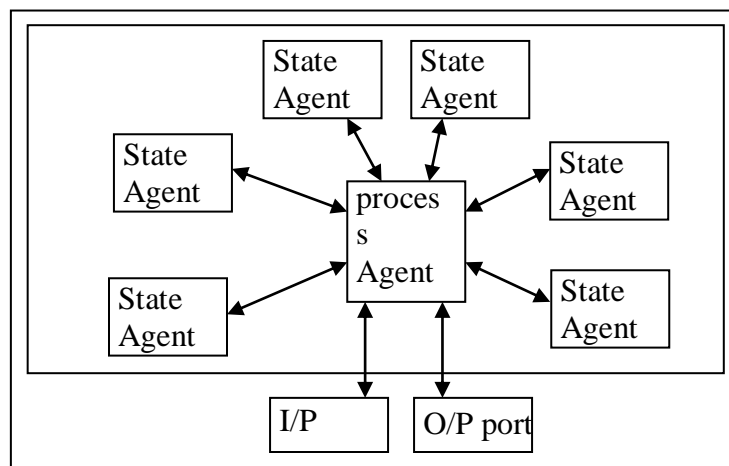


Fig 2: Process agent and agent relationship

## CONTROL SYSTEM DESIGN USING STATE AGENTS AND PROCESS CONTROL AGENT

Consider a process control example of an upper tank refill system (shown in Fig 3) used to store raw/new beverage. The system comprises of a lower tank used to fill the upper tank via a pump. When new beverage is poured in the lower tank, a spring loaded piston on being pressed down by the weight, blocks the light from the Light Emitting Diode (LED) (Obiora-Dimson, Inyama, Okezie, 2013B). This causes the raw beverage to be sucked up automatically into the upper tank via the pump. If the tank indicates full, the pump does not pump up more beverages.

UBVTF is an indicator for full tank, UBVTL is an indicator for low tank while NBV is used to indicate new beverage in the lower tank. BVPMP is used to indicate beverage pump.

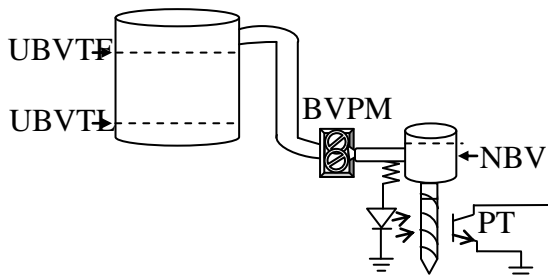


Fig 3: Automatic upper tank refill system

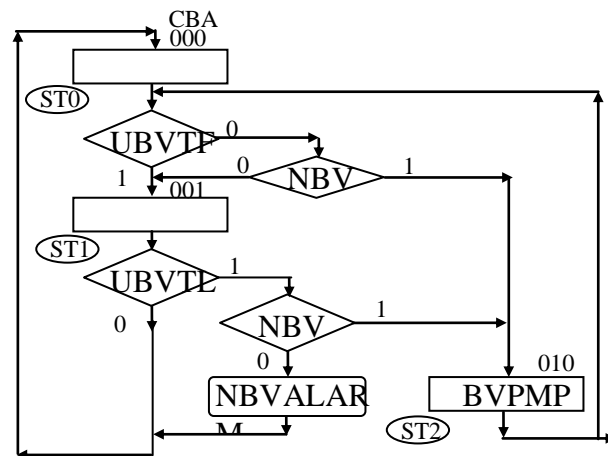


Fig 4: ASM chart of the upper tank refill system of fig 3

The ASM chart representation of the upper tank refill system is shown in Fig. 3. It features three states ST0, ST1, ST2 with state codes 000, 001, 010, respectively. The State Transition Table (STT) representation of this diagram is also shown in table 2 and its fully expanded version is shown in table 3. Suppose that at state ST2 in the ASM chart, the system remains in the loop from ST2, UBVTF=0, NBV=1 for longer than is necessary, then this is an indication of a pump fault. Thus if state code is used to monitor this process, the information contained in the STT (table 2) will indicate the present state of the system at any point in time. This would be used to populate the events table. Thus for such a situation where pump fault occurred, the present state code will continuously indicate 010 over a long period and this will be indicated in the events table. This enables the detection of the pump fault because upper beverage tank is not full (UBVT=0) and there is new beverage in the lower tank (NBV=1) the pump is turned ON and yet the new

beverage remains in the lower tank. That can only happen when the pump has refused to function, though energized.

Table 2: STT corresponding to fig 4

Link path	Present state name	Present state code	Qualifier	Next state name	Next state code	State output	Conditional output
			UBV F UBV L				
L1	ST0	000	0 - 0	ST1	001	0	0
L2	ST0	000	0 - 1	ST2	010	0	0
L3	ST0	000	1 - -	ST1	001	0	0
L4	ST1	001	0 - 0	ST0	001	0	0
L5	ST1	001	0 - 1	ST0	010	0	1
L6	ST1	001	1 - -	ST2	001	0	0
L7	ST2	010	0 - 0	ST1	001	0	0
L8	ST2	010	0 - 1	ST2	010	0	0
L9	ST2	010	1 - -	ST1	001	0	0

Table 3: Fully expanded STT of table 2

LINK path	Present state name	Present state code	Qualifier	Next state name	Next state Code	State output	Conditional output	Agents	Hex output
			UBV F UBV L						
L1	ST0	000	0 0 0	ST1	001	0	0	Agent 0	04
L1	ST0	000	0 1 0	ST1	001	0	0		04
L2	ST0	000	0 0 1	ST2	010	0	0		08
L2	ST0	000	0 1 1	ST2	010	0	0		08
L3	ST0	000	1 0 0	ST1	001	0	0		04
L3	ST0	000	1 0 1	ST1	001	0	0		04
L3	ST0	000	1 1 0	ST1	001	0	0		04
L3	ST0	000	1 1 1	ST1	001	0	0	04	
L4	ST1	001	0 0 0	ST0	000	0	0	Agent 1	00
L4	ST1	001	0 0 1	ST0	000	0	0		00
L4	ST1	001	1 0 0	ST0	000	0	0		00
L4	ST1	001	1 0 1	ST0	000	0	0		00
L5	ST1	001	0 1 0	ST0	000	0	1		01
L5	ST1	001	1 1 0	ST0	000	0	1		01
L6	ST1	001	0 1 1	ST2	010	0	0		08
L6	ST1	001	1 1 1	ST2	010	0	0	08	
L7	ST2	010	0 0 0	ST1	001	1	0	Agent 2	06
L7	ST2	010	0 1 0	ST1	001	1	0		06
L8	ST2	010	0 0 1	ST2	010	1	0		0A
L8	ST2	010	0 1 1	ST2	010	1	0		0A
L9	ST2	010	1 0 0	ST1	001	1	0		06
L9	ST2	010	1 0 1	ST1	001	1	0		06
L9	ST2	010	1 1 0	ST1	001	1	0		06
L9	ST2	010	1 1 1	ST1	001	1	0		06

Full expansion occurs when the dashes are expanded to have all possible binary values. For example a dash can become 0 or 1 while two dashes can become 00, 01, 10, or 11 and so on.

In this context, one may re-organize table 2 as shown in table 3 by placing the present state code field before the qualifier.

We see therefore that the full action of the control system can be handled by 3- software agents, agent 0 through agent 2. Agent 0 determines what the output should be depending on the qualifier whenever the control system is in state 000. Similarly, agent 1 determines what the output should be when the process is in state 001 and so on down to state 010. Note that the output in each state comprises of the next state code and the state output (see table 3). So by invoking agent 0 followed by agent 1 and agent 2 in that sequence, the full operation implied in table 3 would still be successfully executed.

Figure 5 is a microprocessor block diagram implementation of the multi-agent based control system, adapting Clare’s most complete form of a machine model otherwise known as class four machines (as cited in Akpado et al, 2010). Here the feedback C’B’A’ is the next state and when the next clock pulse occurs it is fed forward as present state CBA. Internal control software which is the content of the STT determines when monitored value is low, has marginally increased or has remained the same over time.

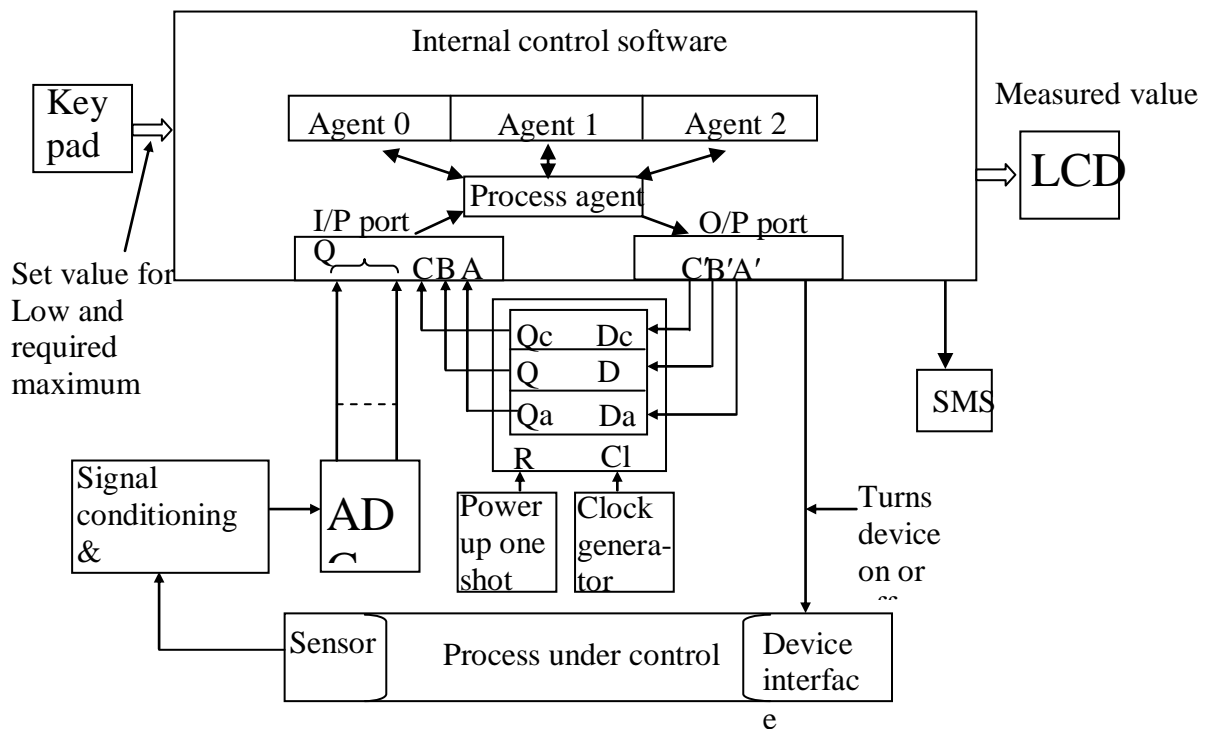


Figure 5: Microprocessor based block diagram implementation of table 3

## MONITORING AGENTS

There is a parallel between the types and number of state (control) agents and the corresponding state monitoring agents. Again, just as a process (control) agent is used to co-ordinate the work of the state (control) agents, a process monitor is used to co-ordinate the work assigned to state monitoring agents. A state monitoring agent monitors the same state that the corresponding state (control) agent is controlling and therefore belongs to the same class as the corresponding state (control) agent. The number of values it is initialized with,

namely,  $V_0, V_1, \dots, V_2^{n-1}$  is exactly the same as for the corresponding state (control) agent because it uses these values to match against those received from the corresponding state control agent as it searches for an error pattern in the feedback received.

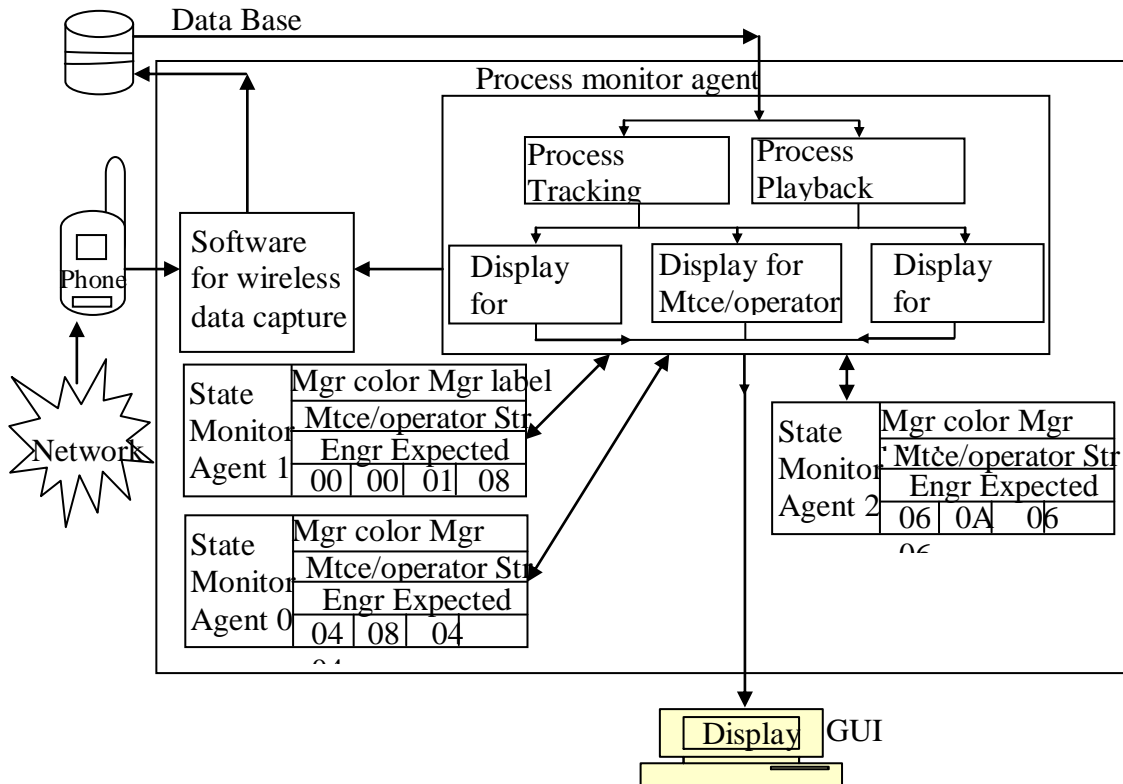


Figure 6: Multi-agent based remote monitoring for automatic upper tank refill

Each state monitor agent has the following features:

- i. A color indicator (G, A, or R), G = Green, A= Amber, and R= Red, to be used when displaying for the manager to show him at a glance whether there is cause to worry or not. The color code (MgrColor) is immediately followed by a LABEL that describes what the system is doing at that state.
- ii. A maintenance string or text used to give maintenance tip to the maintenance personnel or operator should a fault occur at that state.
- iii. Hexadecimal digits showing the state code, qualifiers and the expected feedback byte for that state when the qualifiers are as shown. The expected feedback byte is compared with the actual when displaying diagnostics for the engineer at the bit-pattern level. Depending on the state monitor agent type, the hexadecimal digits can be
  - a. 1 byte long for class 0 monitoring agents- no qualifier
  - b. 2 bytes long for class 1 monitoring agents- 1 qualifier (q=0 or q=1)

- c. 4 bytes long for class 2 monitoring agents – 2 qualifiers ( $q_1q_2= 00, 01, 10$  or 11) and
- d. 8 bytes long for class 3 monitoring agents- 3 qualifiers ( $q_1 q_2 q_3= 000, 001, 010, 011, 100, 101, 110$  or 111).

Fig. 6 is a block diagram showing how a process monitor can use the state agents to place useful information on the GUI display at every state in the process being monitored. The GUI can

- a. Display for manager
- b. Display for operator or maintenance personnel or
- C. Display for engineer depending on the setting of the radio button.

## **SOFTWARE DEVELOPMENT AND AUTOMATIC CODE GENERATION**

It is important to mention that all the codes developed for state agents 0, 1 and 2 are all reusable codes. That means that each can be reused for future control systems other than the one it is designed for. Also the section of the main program that controls the process cycle Fig. 7 is reusable code and does not change from one process control system to another. The only thing that changes from one process control to another is the instantiation of the process agent or state agent indicated as (R). Since the parameters needed for such instantiation operation can easily be communicated to a program as data, it follows that hereafter, agent based control software generation can be automated.

The process involved in developing the control block diagram of Fig. 5 is as shown in Fig. 7 while the process involved in developing the remote monitoring block diagram of Fig. 6 is shown in Fig. 8. Only the block labeled (R) at the bottom left hand corner of Fig. 7 needs to be changed from one process control to another. The remaining nine blocks are written only once and re-used from project to project because of inheritance in object oriented design. Object orientation is thus very useful in that it leads to a high number of software codes that can be re-used in different unrelated projects featuring agent-based design. The box marked (R) in fig. 8 contains the following:

- i. Initialization of process monitor agents and
- ii. initialization of state monitor agents

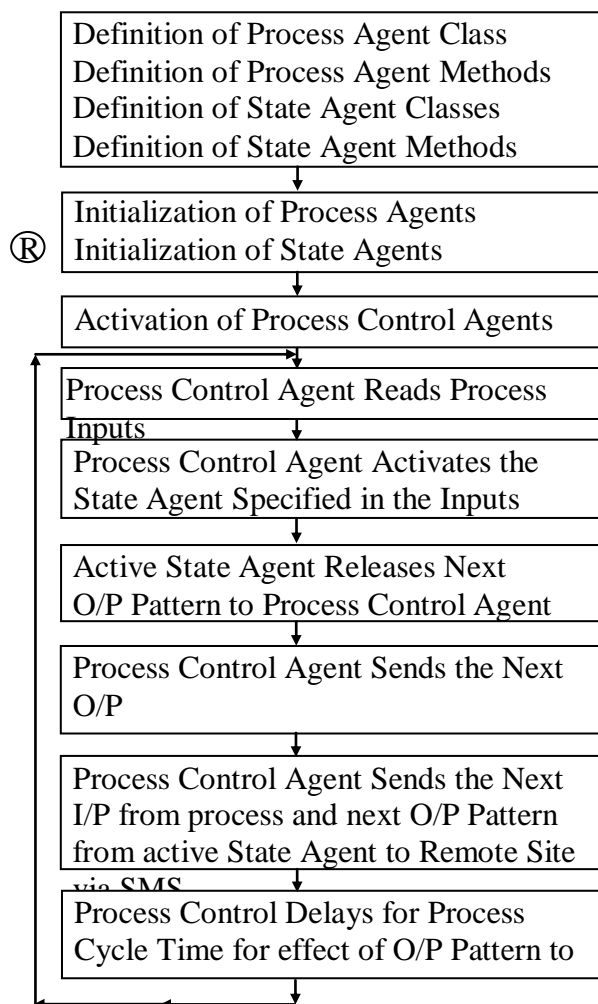


Fig. 7: Program flow for agent-based process control

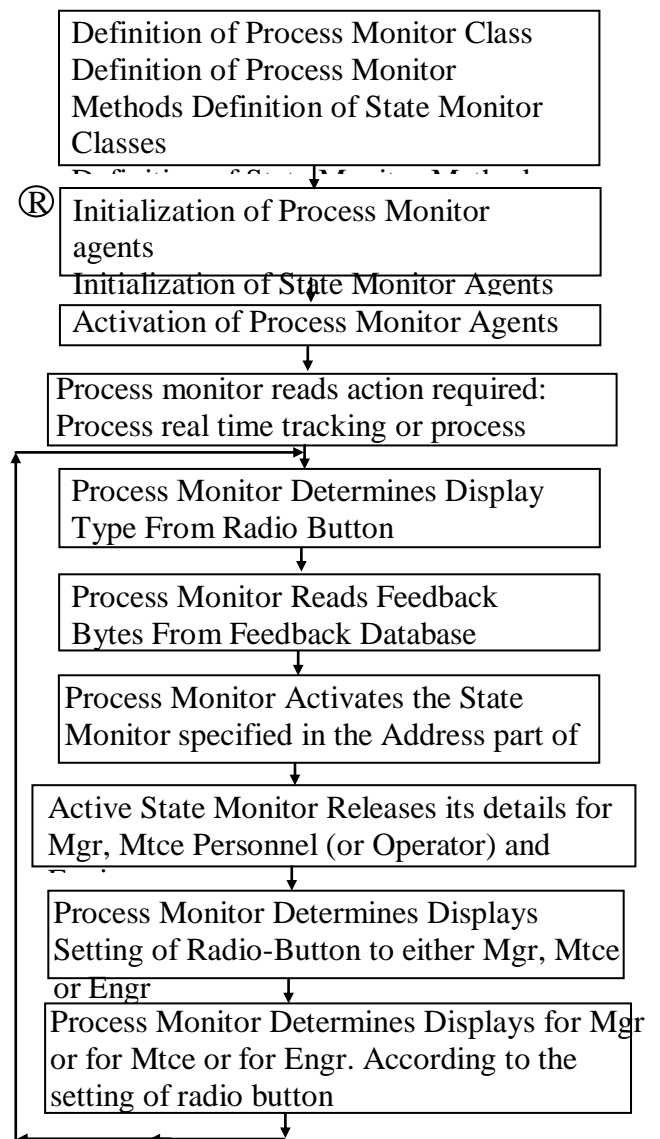


Fig. 8: Program flow for agent-based remote monitoring

The data needed for such initialization are typically derived from the fully expanded STT of the project at hand. Such data (the values V0, V1...Vn-1) can therefore be prompted for and input by the user or stored in a data file and read in automatically by a program. With this done, the rest of the agent-based monitoring software is simply re-usable code. The implication of this is that an automated code for monitoring can be built simply by inputting or reading in the initialization data as suggested above and appending all the codes for the remaining nine boxes of Fig. 8 which are all re-usable irrespective of the differences in the processes being monitored. The automated code generator is therefore comprised of the automated code for control and the automated code

for monitoring with only the data in the boxes marked R in Fig 7 and 8 being the only thing that changes from one application to another.

## CONCLUSION

Automated Process control and monitoring using multi-agent has become more acceptable in recent time. Automatic code generator of the internal software has become less tasking and time consuming because of the technique of automatic code generation. Thus a researcher with any automation design problem that can be tailored to an ASM chart can benefit from the automated code generator design example showcased in this paper.

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