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26th INAUGURAL LECTURE

VIBRATING A NATION TO A STATE OF STABLE EQUILIBRIUM

BY:

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DEDICATION

This work is dedicated to all lovers of education wherever they are especially my parents.

ACKNOWLEDGMENTS

Frankly, the first port of call for my gratitude for the success of this work is to the Lord God Almighty, who preserved me and made today possible to be seen by us all. He is a mighty Creator and needs to be hinged on for all things.

Furthermore, NDU has to be thanked for making this exercise possible and successful. Without her and the Management Staffs that I met on deck when I came on-board this vessel, the exercise would not have been successful. These mostly include the immediate past Vice Chancellor, Prof. Chris Ikporikpo and the incumbent Vice Chancellor, Prof. Humphrey A. Ogoni: the soft, lover of mankind who loves merit, not minding tribe, Prof. Joseph C. Igbeka, the Dean Faculty of Engineering and his team, when I boarded this ship of state cannot be left out of the acknowledgement list. He is a father indeed, who believes on merit also.

The erudite specialist Professors and the members of staff in the faculty of engineering cannot be forgotten in an attempt to say thanks for the success of this work. To the industrious students in the faculty of engineering and especially Department of Marine Engineering, I say well-done for assistant with the success of this work. In this regard, I want to specifically acknowledge Messrs. Anietie Effiong Udo, Ebibaikebuna Albert Orubo and Ogbuku Okaniba who lived on campo-ration and pure water to get this work actualized.

May the Almighty not allow me forget those friends that I came across in Michael Okpara University of Agriculture – Umudike who are too numerous to mention; Engr. Hyginus Ubabuike being most special amongst them all. May God bless you for your encouragements.

My lecturers, colleagues and students in Rivers State University of Science and Technology (RSUST), Port Harcourt need to receive special thanks for the knowledge they imparted to me, the good working relationship they established that gave me a fillip into academics and publishing particularly. In this regard, I must put Dr. Ibiba Emmanuel Douglas, who inspired me into starting a PhD programme; Engr Kombo-Theophilus Johnson – who accepted me from Day one as a brother up to the extent of accommodating me at the on-set of the PhD programme; Prof Kelvin D. H. Bob-Manuel has also to be remembered for vibrating me into being a prominent academician. The role played by Prof H.I. Hart in putting me in this position of prominence cannot be forgotten.

At this juncture, the part played by Nigerian Navy (NN) and Nigerian Defense Academy (NDA) to grant me full release and sponsorship to do a PhD programme cannot be over-emphasized. Consider the magnanimous congratulatory letter issued to me by the incumbent Chief of Naval Staff – Vice Admiral Ibok E. IBAS. This shows how much the Navy, being an educated force loves training and education.

Finally, the members of my family have the most onerous regards in this appreciation note. These include my lovely wife, Mrs. Florence Udeaku OGBONNAYA, children, in-laws, relations, friends, etc who stood beside me even while in "jungle". There are also very many other acquaintances too numerous to be mentioned. You cannot be forgotten, I thank you all.

This appreciation list will not be complete without remembering the medical doctors whom I consulted to correlate vibration in machines to human bodies. They

include Dr and Dr Mrs. Nduka, Dr Blessing E. Akpan, Dr Uchechukwu Ogechukwu Chukwueke, Dr Eme Suku, Dr Ben Osaro and many others to numerous to mention. All my ex-students at undergraduate and postgraduate levels especially Mr Anumiri C.M, Engr Nwogu C.N and Corper Alex Ovundah. May God bless you all.

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The joke of the Navy Officer who bought parrots at 1st Gate Festac on his way back from work.

PROTOCOLS

The Vice Chancellor
Deputy Vice Chancellors
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Bursar
Librarian
The Provost, College of Health Sciences
Dean of Postgraduate School
Deans of Faculties and Student Affairs
Directors of Institutes and Centres
Eminent Professors
Heads of Departments
Academic, Administrative and Technical Staff
My Lords, Spiritual and Temporal
Your Royal Majesties and Royal Highnesses
Chiefs and Elders
Distinguished Academic Colleagues
Great NDU Students
Gentlemen of the Press, Print and Electronic Media
Distinguished Ladies and Gentlemen

1.0 INTRODUCTION

Mr Vice-Chancellor Sir, Permit me to welcome us all to this special August occasion. I also must appreciate the opportunity given to me today to share my academic thoughts and, in a way, the story of academic/engineering life with this eminent audience of dignity, erudite scholars, friends, my colleagues across universities, the public and our students in particular. I am indebted to welcome us all to this special occasion. It is promised that no one present will leave this hall without being blessed.

I equally want to give kudos to my ever-popular, articulated orator for his encomiums (which I cannot say how correct and accurate they are). I want to thank him most especially for specifically recalling that trip to Arab Maritime Academy for Science, Technology and Maritime Transport, Alexandra in Egypt. That trip really placed Niger Delta University (NDU) above University of Lagos and Ibrahim Badamasi Babangida University when it came to acknowledging and executing coning orders. It placed NDU on the world map as a Maritime Institution.

Now to the crux of our meeting here: Ogbonnaya in his numerous research works saw Vibration Monitoring (VM) and analysis as a sub-set of Condition Monitoring (CM). It is in this respect that we want to look at the topic of this lecture from

marine/mechanical point of view to the human/health aspect.

Also as connoted by the theme of this lecture "Vibrating a Nation to a State of Stable Equilibrium", it is obvious that the concept of vibration as analyzed and stated in Ogbonnaya's research works can be as well extended to solving socio-economy problems of a Nation, especially that of Nigeria at present. Nigeria today is faced with problems of insecurity, corruption, politic, leadership and many more to mention. A critical look into these problems in terms of solutions offered by works on vibration, the solution to our socio-economy problems can be modeled.

1.1 Aim

The aim of this lecture is therefore to showcase the contributions of Engr. Cdr. Prof. Prince Ezenwa Alfred Ogbonnaya to National Development through engineering expertise as a Ship Power Plant engineer.

1.2 Scope

To accomplish the above aim the following scopes will be considered as they concern Prof Ogbonnaya's achievement in the specific field of vibration monitoring and analysis in the Marine and Maritime engineering profession.

a. Definition of VM
b. Advantages/disadvantages of vibration and VM to machinery and human maintenance
c. Specific components of VM
d. Prof Ogbonnaya's first and onlies
e. Achievement in software design.
f. How VM/Vibration Amplitude measurement helps us survive/grow/overcome life's challenges/stress.
g. Chapter contributions
h. Computer simulation works
i. None software related publications
j. Works in favour of Niger Delta
k. Ship design and construction
l. Enhancement of operations in the maritime industry.
m. Other minor productive works
n. Book publications.
o. Conclusion and Recommendations.

1.3 Definitions

The Oxford Advanced Learners English Dictionary defines "vibrate" as to "shake", to "move", to "oscillate", to "swing", to "change to and fro", especially rapidly. Thus, vibration is a state of being vibrated; a whole period

of movement to and fro of anything vibrating.
According to Ogbonnaya (1998), vibration is a pulsating motion of a machine or machine elements, components and sub-components from its original position of rest and can be represented by the formula:

$$\text{Vibration amplitude response} = \frac{Dynamic\ force}{Dynamic\ resistance}$$

Ogbonnaya (2004), joined other world engineers to define VM as the process of acquiring vibration signatures with meters/monitors with a view to using the spectrum from the acquired signature to make/take proactive maintenance decisions.

1.4 Instrumentations
Equipment called meters or monitors generally are used to know the level of vibration, equipment is producing or is being subjected to or is undergoing. These facts can be buttressed by using the followings: old methods of monitoring:

a. Setting a coin on its edge
b. Using a screw driver
c. Feeling the working member
d. Noise/ sound
e. Experience

Modern methods of monitoring:
- Use of meters (portable equipment) that can be carried from place to place to acquire vibration readings.

- Use of monitors (fixed vibration monitoring equipment) for taking vibration signatures. They have been extended in Ogbonnaya, (2000), from contemporary days and styles to computerized systems that give outputs just at the press of buttons. Ogbonnaya (2004), equally talked of many of these fittings especially the Ships Integrated Monitoring System acronym, SIMOS, fitted on NNS ARADU.

  For the human system, the stethoscope commonly used by Doctors is a typical and sophisticated instrument for acquiring vibration signatures from the heart. So there are similarities between acquisition of vibration signature from machines and human beings.
  Vibration signatures are acquired in three main units, namely displacement (m), velocity (mm/s) and acceleration (mm/s^2) (Ogbonnaya,1998).

  In Ogbonnaya (1998), it was also establish that VM and analysis is one of the most important components of CM. In the same reference, it was discovered that coupling VM with lubricating oil analysis (another essential element of CM) makes the practice of CM very meaningful.

  This implies that to an engine, lubricating oil is like blood to a human system. No wonder Doctors send blood sample for analysis during medical examinations, (Okah-Avae, 1996) and they still use the stethoscope to find the vibrating level of

the heart.

In Command and Staff College (CSC) Jaji as a student of the Senior Division Staff Course 22;a research, conducted then, and published in Ogbonnaya (2000), it was established, amongst other facts that:

a. The University is a part of the Maritime Industry
b. The facts discovered in Ogbonnaya (1998) were correct
c. Human vibration vis-a-vis shivering when a child has fever gives indication of the severity of the fever.
d. That VM is a very important aspect of maintenance, while maintenance is what we do to engines, equipment, components, and machinery to keep up their operational state. The human body also is maintained to keep up its operability. Therefore, this lecture is also to let us know that, just as we maintain engines, we also need to maintain our bodies. The best form of this maintenance is the proactive type where we do not need to break down or fall sick before we take care of ourselves.

1.5 Advantages of Vibration

According to Ogbonnaya (1998), the collection and analysis of vibration data allows for three important analysis techniques to be performed as follows:

I. Certification

II. Potential Fault Analysis
III. Diagnostic Techniques

1.5.1 Certification

Vibrations data is taken on new and/or rebuilt machinery to ensure that the machinery is operating within acceptable vibration tolerances in terms of velocity amplitude in mm/sec. The machinery will not be certified for use, if excessive vibration is discovered. The cause can be remedied before the machinery is put into service.

1.5.2 Potential fault analysis

Potential fault analysis being a component of predictive maintenance helps in the determination of the health of machine components. Diagnosis or fault analysis is preceded by monitoring and followed by rectification, documentation etc. A good assessment of machine health allows the prediction of the component that is most likely to fail. An approximate period that the component will continue to operate before fault occurs can also be predicted. This information allows the operator to anticipate and schedule machine overhauls, thereby minimizing shutdowns and avoid damage that results from catastrophic failures.

In potential fault analysis, information about the machine is used to determine the number and location of data collection points. Machine information includes the number, type and location of bearing; the type and location of couplings, and machine components (turbine, pump, generator etc.). A carefully maintained potential fault analysis program, coupled with that of machine

maintenance, ensures long, trouble-free operation of plant, machinery, etc.

1.5.3 Diagnostic techniques

Diagnostic analysis is reactive whereas potential fault analysis is more proactive. Diagnostic analysis is only performed once a fault has occurred. Often times the problem is so severe that the equipment has to be shut down for safety reasons, and potential fault analysis carried out. Diagnosis begins with the same steps as potential fault analysis.

As explained in potential fault analysis, some actions precede diagnosis while others follow it. This is why it is referred to as being reactive. Potential fault analysis is proactive because it has to take place before the fault occurs. It is therefore predictive and steps have to be taken to avert the fault.

All the above also apply to Human Health Monitoring (HHM) and techniques. Engine Health Monitoring as well as HHM are carved out to certify the state of health, diagnose and analyse the state of health before a stability can be ensured (Ogbonnaya, 1998).

1.5.4 Stability - The Big Shot

Unless you have been vibrated, you can never be STABLE. Example is in the vibration and non-vibrated block. Block moulders will tell you that there are two types of blocks- the vibrated and non-vibrated blocks. The vibrated blocks are normally shaken, rocked before being certified ready for usage. Practically, they are

stronger, more durable than those that are not vibrated.

1.6 Disadvantages of Vibration

- Vibration makes nuts work loose during engine operation.
- Vibration makes people get easily and quickly tired during watch – keeping.
- Over vibration just like insufficient vibration introduces asperities which later lead to crack during engine operation.
- Vibration makes vessels to be easily detected by submarines during submarine warfare and even leads to submarine detection by noise/ vibration seeking missiles.

1.7 Balancing

In the process of carrying out vibration monitoring and analysis, balancing often come into play, when the vibration becomes excessive. This is why some works were carried out specifically with some international researchers on rotor balancing (Orji and Ogbonnaya, 2016: Tamunodukobipi et al, 2017)

2.0 PROF OGBONNAYA'S "FIRST' AND "ONLIES"

a. The first Sub-Lt in the history of Nigerian Navy to be Marine Engineer Officer (MEO), not Ag MEO, of Nigerian Naval Ship, (NNS) DAMISA- one of the German-built Fast Attack Patrol Craft.

Fig 2.1: NNS DAMISA in action at sea

b. During his training in Indian Naval Ship (INS) SHIVAJI, he was the first only Nigerian Apprentice to come first from A-term to F-Term, a term being for 5½

c. The only Nigerian who physically presented a paper alone in an International Gas Turbine Institute (a division of American Society of Mechanical Engineers) conference in Orlando-Florida, USA (Ogbonnaya, 2009b). This is depicted in fig 2.2.

Fig 2.2: Picture of paper presentation in Florida, USA

This paper was presented between 1015 and 1045 on Thursday, June 11 2009 in the Paper session on Controls, Diagnostics and Instrumentation (CDI) in a Room called Grand 6. ThB 5-15 and Chaired by William Rhoden of Hamilton Sundstrand Corporation Windsor Locks, CT-USA. (www.turboexpo.org)

d. In 2010, under another CDI session chaired by Dave Doel of GE Aviation, Evansdale, OH, USA, he was the only West African to present a paper which he co-authored with Engr. KomboTheophilus Johnson of Department of Marine Engineering, Rivers State University of Science and Technology Titled: "Use of Multiple Variable Mathematics Method for Effective

Condition Monitoring of Gas Turbines" (GT2010-22568) which took place in Room: Carron 1. Secc.MB-5-2 on June 14, 2010 between 3:30-4:00 (Glasgow, Scotland, UK).

e. Also, in 2012, this Prof Ogbonnaya was in Bella centre, Copenhagen-Denmark for another IGTI ASME conference with Engr. Hyginus Ubabuike Ugwu of Department of Mechanical Engineering, Michael Okpara University of Agriculture, Umuahia to present another paper Ogbonnaya, et al 2012a in Room BV2/3.MB-5-6).There are other co-authors for this paper who could not make the trip to Denmark. (Paper was between 3:30-4:00pm) in Scottish Exhibition and Convention Center. We were the only Africans whose paper was accepted for the conference and Prof Ogbonnaya presented the paper. It was also under the GTCDI session.

f. There now came a digression where emphasis was shifted from GT-CDI to ship design, boat building and construction. In 2013, Prof Ogbonnaya thus also made an outing to Seattle Washington, US for presentation of a paper. He was the only African in this conference which took place in Hyatt Regency Houston- Huston La Texas, USA.
A snap shot he had during the conference is shown in fig. 2.3, (Ogbonnaya, 2013a).

Fig 2.3: Picture taken during a trip to present a paper in Huston, USA.

g. During 23rd AGM and International Conference Institute of Mechanical Engineers (A division of NSE) held in Alfred Diete Spiff Civic Center, Moscow Road, Port Harcourt between, 20-22 Oct, 2010 and Prof Ogbonnaya the Marine/Mechanical Engineer was the only Marine Engineer who presented paper titled: "Simulation of Diesel Engine Speed Related Characteristics" (Ogbonnaya 2010a).

h. His project team won the George Stephenson's prize for the best Design and Make (D&M) Project in Royal Naval Engineering College (HMS THUNDERER), Manadon-Plymouth England. The picture of the work D&M of a Mooning Buoy Tender is portrayed in Fig 2.4 (MacRae, et al, 1998).

i. Prof Ogbonnaya is the first lecturer from the Department of Marine/ Mechanical Engineering to present an inaugural lecture in Niger Delta University

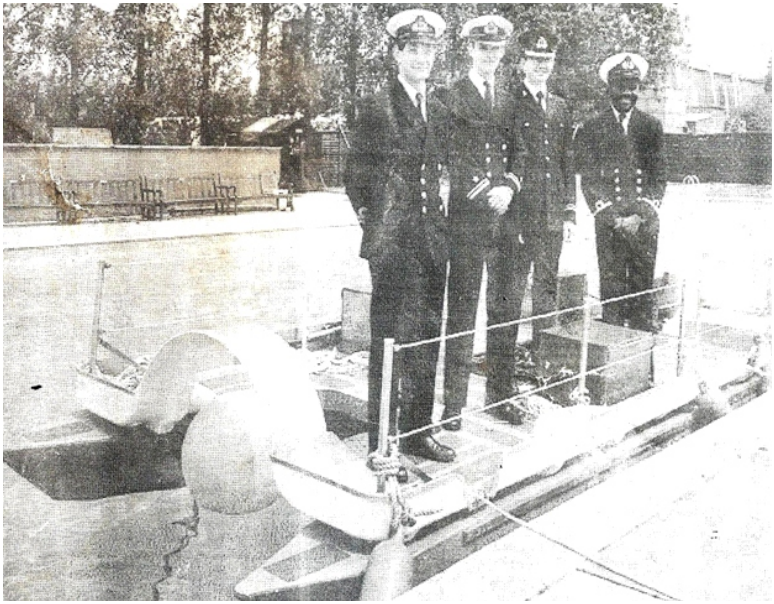

Fig 2.4: Prof with his project team in Manadon-Plymouth, England.

2.1 Ogbonnaya-The Software Developer

Since his days as an M.Tech student, the man Ogbonnaya started with development of engineering software for solving various technical problems. These are in the following areas:

a. An unnamed computerized software was developed in Ogbonnaya (1998) for solving torsional vibration

problems using the Holzer-Torsional Vibration Method with Q-Basic programming language.

b. Another computer-based program which can take care of air intake differential pressure calculation was also devised (Ogbonnaya, 1998). This software was later further developed and code-named "TOPA".

c. Flowchart for boost pressure calculation presented in Ogbonnaya (1998).

d. Condition Monitoring of a Diesel Engine for Electricity Generation contained in Ogbonnaya (1998)

e. Very important software code-named "The MICE", for the detection, analysis, proactively prevention or solving impending downtime in a GT was enunciated in Ogbonnaya (2004).This work eventually led to the development of several other named software as evidenced in the Ogbonnaya's numerous publications.

f. In Medwell Journal and Ogbonnaya (2010b), a computer simulation was carried out to determine using diesel engine air intake filter to know the health of an engine while in operation.

g. Top-B in Ogbonnaya, et al (2010), the requirements for reliability of machines that perform different technological processes and their faults diagnoses have become much stricter on most plants. The individual component models are used to generate the

source or cause of fault in the engines. Component models are thus used to generate output variables for the effective and efficient health monitoring of the engine. During the measurements, the particular component must be in a healthy condition as shown in fig. 2.5. The failure of these components poses a great problem to the equipment manufacturers and owners. A step to the reduction of the faults led to the execution of this work using gas turbine engines as case studies. Component parametric readings collected from a gas turbine engine on industrial duty for power generation were used to enunciate steps to solve the problem by simulating likely deterioration in its component data. A computer program code in Visual Basic was used to actualize the simulation. The results obtained show that early detection of faults could help to avoid catastrophic downtime.

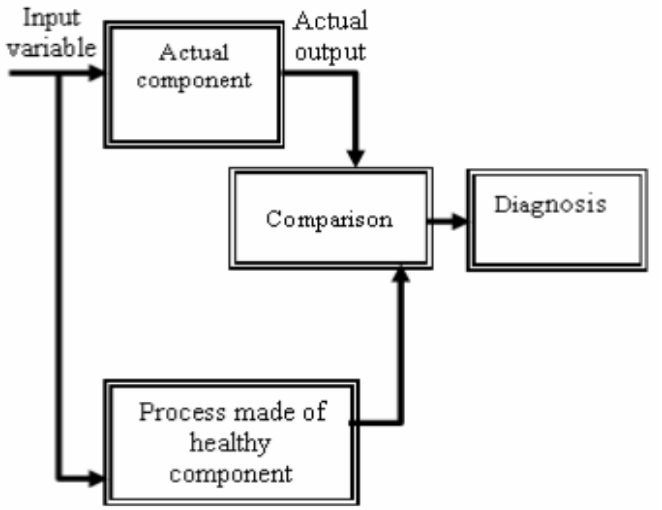

Fig. 2.5: Component model for monitoring and diagnosis.

h. Dynamic Modelling of Gas Turbine Rotor Shaft-Faults enunciated in Ogbonnaya (2009b) is another work where modelling through computer simulation can be used to diagnose rotor shaft faults.

I MDE Performance Analysis: MDE are subject to both stresses and vibration due to the environment in which they operate, thereby impeding their performance. The essence of this project was to enunciate a proactive solution to any catastrophic breakdown a marine diesel engine may suffer as a result of environmental factors and vibration. In this paper therefore a method to optimize the performance of the MDE towards effective CM was carried out. A four stroke caterpillar 3516B series marine diesel engine with 16-VTS was used to actualize the work. The theoretical evaluation and analysis were used to calculate the values of pressure, volume and temperature under different speeds and power output at the beginning of ignition. These evaluation and analyses helped to find the different power outputs of the engine at different speeds. A computer program code named MDE Performance Analysis(MDEPA) written in Visual-Basic programming language was developed (Ishiodu and Ogbonnaya, 2011)

j. A very important unnamed software to improve the efficiency of marine power plants through combination of two plants working simultaneously (cogeneration) was published in Ogbonnaya, et al (2012a)

k. Another coded MATLAB computer program was used to mathematically know when surge and stall begin in a GT compressor. Surge and Stall are great enemies to flow of air through GT rotating parts (Ogbonnaya, 2010c)

l. A software in C^{++} computer programming language was used to show that air/fuel ratio of 10.9:1 and 14.4% excess air are needed for effective performance of the combustion chamber in order to give an optimal turbine network output. (Kombo, et al, 2012)

m. A software code-named VANCANAL written in C^{++} programming language was used to proactively monitor the GT plant. The software displayed the operational (actual) values of all the parameters of the engine against their designed values. Once the set limit in exceeded, the software triggers an alarm, signifying the need for maintenance Ogbonnaya (2012a)

n. A program coded in Visual C#. Net was used to actualize work on "simulating Gas Turbine Bearing failure Towards Effective Condition Monitoring". This program is able to detect likely defects that could lead to downtime (Ugwu and Ogbonnaya, 2011) resulting from vibration.

o. In a paper Ugechi, et al (2000), coded software was used in the computer-based diagnostic tools employing an Artificial Neural Network (ANN) to analyse the ensuing machinery faults, their causes and

consequences. For various categories of this type of machinery, a vibration-severity chart (ISO 12372/BS4675:1971) approximately colour coded according to defined mechanical faults was used to train the network. The model was validated using data obtained from a centrifugal pump on full load and fed into the program written in Visual Basic (VB).

p. A computer-based analytical model was also developed, in VB for monitoring machine failures. This led to an integrated systems-process algorithm for diagnosis of faults in rotating components (Ede, et al, 2010).

q. Faults due to high vibration amplitude were analysed using a program done in MATLAB. The Optimization Method used was coupled with CM to come up with a method of effectively analysing GT rotor shaft faults detection, identification, analysis and solution (Ogbonnaya and Kombo, 2011), which has 300 views as of 27th August, 2015. (See Appendix B)

r. MDE Performance Analysis in Ishiodu and Ogbonnaya (2012)

Fig. 2.6, shows the relationship between the different efficiencies at various speeds of the engine under investigation. It equally depicts that the division of brake power by the indicated power would give the mechanical efficiency which implies the degree of performance of the engine. The graph shows that the best performance occurred at the designed speed of

1600 rpm.

This software came into being as a result of Bob-Manual et al (1999), which is however not computer-based. Here, the software promulgated is to enunciate a proactive solution to any catastrophic downtime the MDE could suffer as a result of environmental factors and vibration.

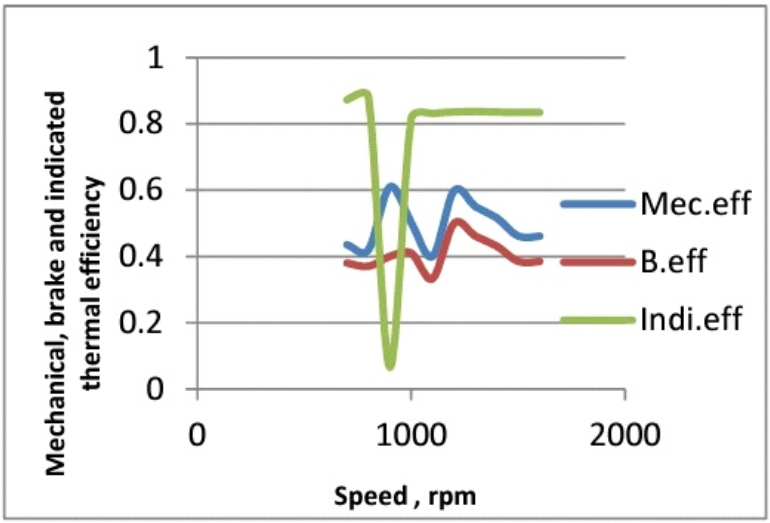

Fig 2.6: Graph of mechanical brake and Indicated thermal efficiencies against speed.

s. The software generation/development/production were not only about vibration and GTs. In Ugwu et al, (2011), a program in MATLAB programming language was developed where the researchers used ANN to sequestrate and characterize the properties of coal. The work is of immense benefit as it is of help in reducing the over-dependence this country is wielding on oil today.

t. According to Ogbonnaya, et al (2010) SCONOX and PRONOX were used to show the impact on the Environment of GT Exhaust in NSE International Conference and Annual General Meeting (AGM) (6-10 December, 2010) in International Conference Centre (ICC), Abuja. Theme "Engineering Response in Combating the Effect of Climate Change in Africa. $SCONO_x$ means Selective Catalytic Oxidation of NO_x while $PRONO_x$ is Proactive Oxidation of NO_x. $PRONO_x$ is a step ahead of $SCONO_x$ though it is a later technology.

u. A software name ENVIMS written in C^{++} programming language work (Ogbonnaya, et al, 2012b) was also developed to solve GT vibration issues.

v. A program in C^{++} for determining the Dynamic Response of a GT Rotor Shaft published in Gas Turbines Materials, Modelling and Performance, INTECH chapter contribution by Ogbonnaya, et al (2015), which had 5000 downloads (See Appendix C).

w. An unnamed software was used to determine the location of a crack on the rotor shaft of the GT system. The work was carried out after it was discovered that asperities and blowholes form part of the defects that lead to cracks in the shafts. The occurrence of those anomalies at manufacturing stages would lead to greater downtime during engine operations/usages (Ogbonnaya, 2003). If you agree with me that the rotor shaft of the GT is liken to human vertebrae, it is better to apply back-economy from youthful ages than wait to have backaches at old age.

x. The impact of fluid flow in Internal Combustion Engines (ICEs) cannot be overemphasized. This is why a combination of modern computer applications, namely; ANSYS, SOLIDWORKS, were used with Computational Fluid Dynamics to model the performance of flow through the port of an ICE. 63 Iterations were practically performed in this experimental work in NDU, department of Mechanical Engineering, Fluid Dynamics and Skill G laboratories to identify the best flow regions and pressure for optimal performance of ICEs (Ajoko and Ogbonnaya, 2016).

2.2 Advantages of Software

Software are very important facets in engineering technology and practices. They help in making engineering problems easy to solve. They also help in tackling special aspects of engineering, and simulations, particularly.

3.0 CHAPTER CONTRIBUTIONS

1. In THERMAL POWER PLANTS Edited by Mohammed Rasal titled: Adaptive Gas Path Modelling in Gas Turbine Health Monitoring. This publication received 300 downloads as at 27th August, 2015 and 5,000 downloads as at 21 November, 2015. See Appendices B and C as reported by Research Gate. Here, the ability to model the behaviour of GTs is critical in all aspects of energy and power generation engineering. A computerized approach giving the possibility for a more detailed gas path component fault diagnosis and prognosis using the Multi-Variable Response was presented.

A diagnostic engine performance model is the main tool that points to the faulty engine component. The diagnostic component model was also used to come up with the software code-named Thermodynamics and Performance Condition Monitoring (THAPCOM) written in C++ programming language to effectively identify the fault on the engine. Several scheduled visits were thus made to AFAM IV, GT 18, TYPE 13D power plant located near Port Harcourt, in Rivers State of Nigeria. Continuous and

periodic monitoring of the thermodynamics/performance parameters such as temperature, pressure, air pumping capability, rotational speed, air, fuel and gas flow were carried out. This exercise lasted for period of three months on hourly basis to predict the health of the engine (Ogbonnaya et al, 2011).

2. A considerable impact was made on the modelling of dynamic characteristics of rotating structures. Some of the dynamic characteristics of interest are critical speed, systems stability and response to unbalance excitation. In the case of Gas Turbines (GT), the successful operation of the engine depends largely on the structural integrity of its rotor shaft. The structural integrity in turn depends upon the ability to predict the dynamic behaviour or characteristic accurately and meet the design requirement to withstand steady and vibratory stresses. An accurate and reliable analysis of the rotor shaft behaviour is therefore essential and requires complex and sophisticated modelling of the engine spools rotating at different speeds, static structure like casing, frames and elastic connections simulating bearing. In this work, GT rotor shaft dynamic modelling will be based on the speed and the force response due to unbalance. During the design stage of GT rotor shaft, the dynamic model is used to ensure that any potential harmful resources are outside the engine operating speed.

Engine vibration tests are part of the more comprehensive engine test program conducted on all development and production engines. Rotor shaft unbalance is the most common reason in machine vibration (Ogbonnaya et al,

2015). Code name: GTB Vibration, which has 50 views (See Appendix APPD) as at Tuesday, November 17, 2015.

3. An un-coded/unnamed software was designed for use to determine Component Model-Based Condition Monitoring of a Gas (Ogbonnaya, et al, 2010), which has 200 views as at July 23, 2015. (See Appendix E).

4. A high level Java computer program was used to proactively diagnose the operation of a GT engine through its thermodynamics and rotor shaft vibration signature analysis (Ogbonnaya, et al, 2013a)

5. Ogbonnaya (2010c) "Modelling vibration effects of Surge and Stall on GT Compressors where a MATLAB Computer Programming Language was used to look at the sequence of occurrence of events that could lead to catastrophic downtime in Gas Turbines.

The performance efficiency of power plants is of great importance to engineers and every nation. Organizations have thus embarked on different maintenance management strategies to ensure high reliability of plant availability. To meet these challenges, one way is to check the growing energy demand and to develop new maintenance strategy for power plant's availability. In-view of this, it became necessary to propose a new additional strategy to save the GT from catastrophe through the consideration of its rotor shaft vibration.

4.0 WORKS USING ANN

The main aim for creating ANN which is a subset of artificial intelligence is to provide a simple model of human body in order to solve complex scientific and industrial problems. Aerospace, automotive, manufacturing, medicine, oil and gas, telecommunications, robotics etc. are just few areas where ANNs provide outstanding solutions. Fast computers have made it possible to use neural network to solve complex industrial problems that formerly required too much computation. Fig. 4.1 and 4.2 show neural network architecture is a system composed of many simple processing-elements, operating in parallel and whose function is determined by the network structure. Fig. 4.3 shows the way a neuron works.

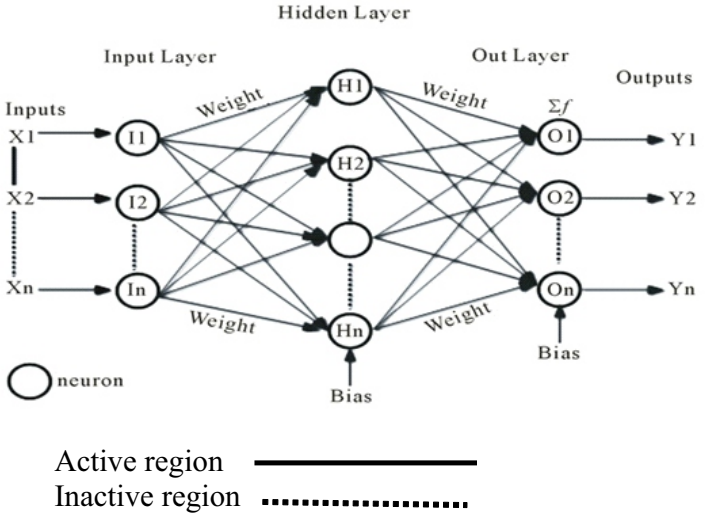

Fig 4.1: A typical Neural Network Architecture (Ogbonnaya, 2004)

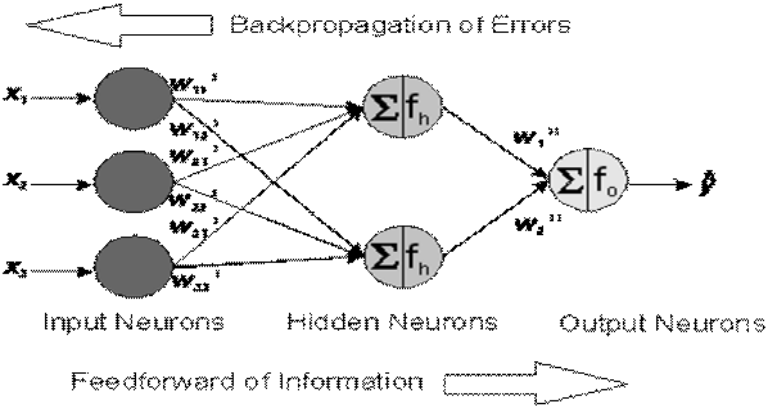

Fig 4.2: A 3-Layer back propagation neural network (Ogbonnaya, 2004)

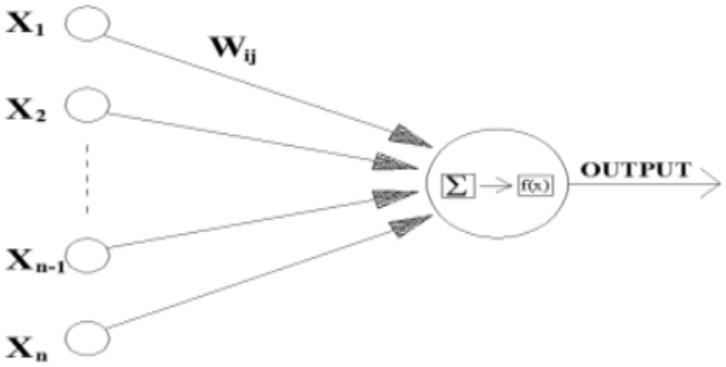

Fig. 4.3: Operation of a Neuron (Bob-Manuel et al, 2004)

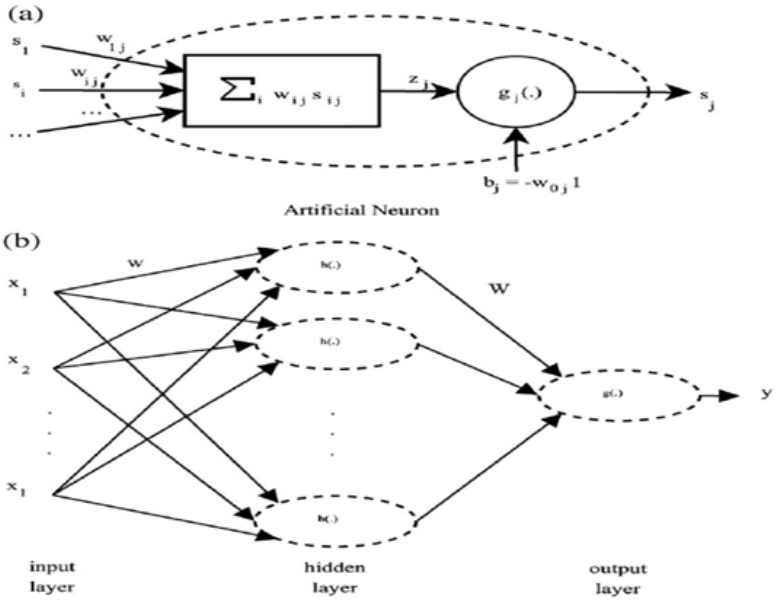

Fig 4.4: Schematic representation of a neuron (Ogbonnaya et al, 2013e)

The new methodology took into consideration most of the existing monitoring methods and integrating Artificial Intelligence (AI) method of Artificial Neural Network (ANN) into it [2-4]. ES is an intelligent agent that perceives its environment and takes action that maximizes its chances of success. ANN is a branch of AI that is suitable for establishing intelligent fault diagnostic systems.

Inspired by the structure of the brain, ANN consists of a set of highly interconnected entities called nodes or units. Each unit is designed to mimic its biological counterpart, the neuron and accepts a weighed set of inputs and responds with an output. This process was actualized as follows

1. In his PhD work (Ogbonaya 2004a) where VB programming language was used to monitor the Vibration level of a GT plant (GT 17 in Afam Thermal Station.) similar to the monitoring of human health and is also important.

2. Also in the same PhD thesis ANN was used to validate the work done on both shaft and bearing vibration monitoring and analysis.

3. A VB. net computer programming language was used to develop software employed to create a complete analytical model of the COGAS plant using data collected from gas and steam turbines on industrial duty for electricity generation/ production at thermal station in Ogorode-Sapele. (Ogbonnaya at 2014)

We know that wise maintenance procedures are essential for achieving high industrial productivity with low energy expenditure. A major part of the energy used in any production process is expanded during the maintenance of the employed equipment. To ensure plant reliability and equipment availability, a conduction-based maintenance policy was developed in a project exploring the integration of ANN into vibration-based parameters to detect faults in rotary equipment. The collected vibration signature was used in the training of the ANN. The model was validated using data obtained from a centrifugal pp. On full-load and fed into a program written in VB the evolved diagnostic and prognostic model is applicable to other rotary equipment as well as human health (Ugechi, et al, 2009).

In 2004, as a PhD student, an ANN computer-based program was enunciated where the defect emanating from the rotor shaft of a GT engine could be proactively handled. A system of pattern recognition techniques for faults classification was used to train the network with double hidden layer. Results obtained show that most faults concerning the GT rotor shaft can be effectively and successively diagnosed by this method. Why this can't be extended to the human health especially where it concerns the vertebrae (Bob-Manuel et al, 2004).

4.1 Computer Stimulation Works

1. Compressor Water-Washing

Figure 4.5 shows the enthalpy versus entropy map of a compressor. It is between 2 and 2' that water washing takes place where a computer program code in VB was used to actualize the simulation. The results obtained shows that early detection of faults could lead to avoidance of catastrophic downtime just as it happen in human health; also the research revealed that the pressure drop across the turbine should not be more than 11.4bar for optimum performance. After all medical practitioners have set-limits of temperature and pressure for human

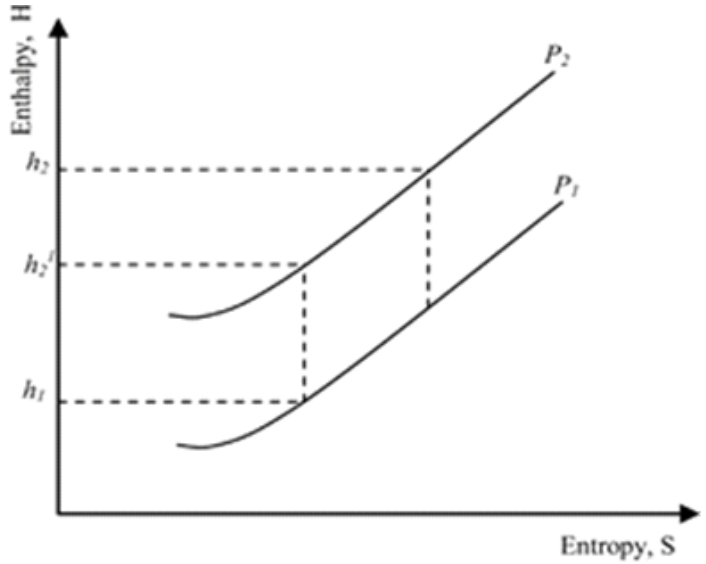

Fig 4.5: Enthalpy versus entropy map of compression

2. VICOMS: Vibration Instabilities of Condition Monitoring System was developed in Computer Aided Solution to Vibrational Effect of Instabilities in GT Compressors by Ogbonnaya, et al, 2010.Here C^{++} programming language was used to develop a software where it was established that GT wouldn't be run above 14.0mm vibration displacement amplitude due to surge, stall and other flow induces catastrophic breakdown. Computer simulation has been shown to be a very successful tool for anomaly detection when coupled with statistics.

3. In Ogbonnaya and Ugwu (2012), a C^{++} programming language was used to actualize the simulation. Also statistical Z-test method was used to show that a linear relationship exists between the operational data used and the simulation carried out.

4. The Marine Gas Turbine (MGT) in many respects is the most significant means of creating mechanical power among the other various means. Although GT obtain their power by utilizing the energy of burnt gases and air which are at high temperature and pressure while expanding through several rings of fixed and rotating blades. GTs are increasingly being used all over the world for various applications, some of which include power generation, aero-propulsion, propulsion of ships, operation of pumps and compressors. In Nigeria, GT is used mainly for electricity generation, base-load operations, standby power generating plants including aircraft and ship propulsion. Most oil companies like Agip, Chevron, Elf and Shell also use gas turbines for

electricity generation and other purposes.

5. Inefficiencies of compressors and turbines resulting from insufficient pressure ratio at successive blade stages in GT often lead to flow reversals. A step to statistically correlate boost pressure and vibration velocity amplitude to avoid such flow reversals therefore led to the execution of this research. A computer simulation technique was used to actualize this purpose with the operational data obtained from Delta IV unit of Ughelli power station GT 18 using VC++ programming language. Results obtained show that maximum vibration manifests on each of the bearings at a pressure ratio of 9.47 for all cases considered. These results further show a linear relationship between the data using statistical z- test (Ogbonnaya and Ugwu, 2012).

6. In Asima and Ogbonnaya (2016), ANSYS and CFD programming technique were coupled to computationally produce a procedure to analyse issues in contracting transition ducts. Three ducts were subjected to different temperature, velocity and pressure conditions with results corresponding to manual calculations.

7. From the graph shown in fig 4.6, it is observed that an increase in pressure ratio results to a corresponding increase in vibration velocity amplitude to some extent. Here, maximum vibration occurs at a pressure ratio of about 9.47 with corresponding vibration velocity amplitude of 3.84mm/s,

The figure shows pressure ratio against their respective vibration velocity amplitudes for the test engine. The graph shows that the experimental and simulated values for pressure ratio and load correlate suitably. The deviation for the vibration amplitude is so much out of range because of the erratic and unpredictable nature of that parameter. Hence a lot of attention needs to be given to take care of vibration signature and its average effects at design stage.

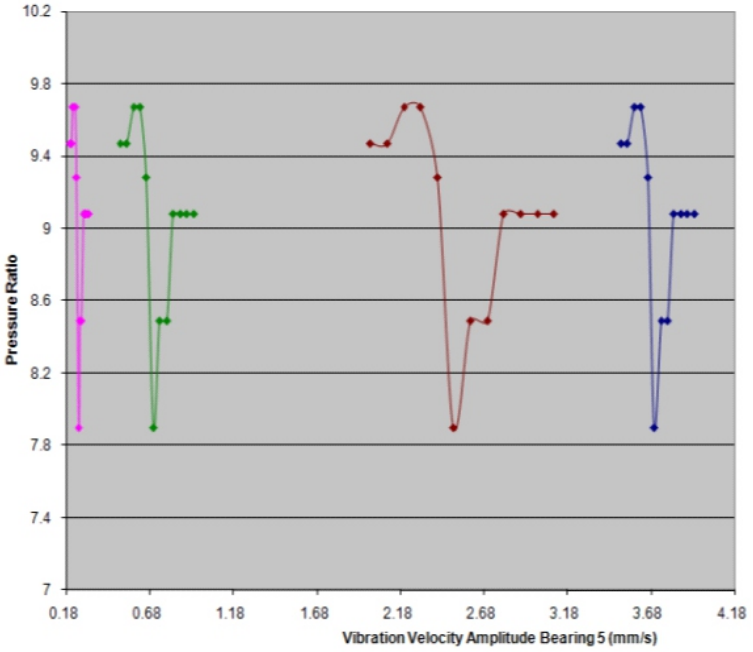

Fig 4.6: Graph of pressure ratio against vibration velocity amplitude

This is also related to human life. Normally at the tender or earlier stage in life, the body responses positively to stimuli with ease. After years have gone by, the body system gets weaker and much care and attention need be rendered to the body for its proper functioning. The body does need to be vibrated much due to the weakness of the body system. That is the major reason why Doctors give special attention to Elderly patients in the hospital.

8. Recuperation means Invigorating or adding energy. This technique was used in: Ogbonnaya and Ugwu (2012) to show that the energy of steam can be invigorated using the heat from the GT exhaust, that would have been wasted.
Here VB.Net computer programming language was used to actualize the work done on 2×191mw steam Turbine and 6×118mw GT plants (Tahoka COGAS plant in Niigata, Japan). (Ogbonnaya, 2004; Ogbonnaya, 2014a).It was shown that the feed pump of a boiler system is like the human heart which constantly supplies blood to the entire body. It therefore needs so much of proactive care.

9. Heat exchangers, Computer Numerical Control machines and Diesel Engines were not left out in showing how computer simulation can be effectively applied in systems upkeep. These are depicted in Ogbonnaya (2006b), Ogbonnaya et al (2013a), Nitonye and Ogbonnaya (2015) and Ogbonnaya, et al, (2015).

4.2 Advantages of Simulation

Design is a very important aspect of any engineering production. To be able to check/ determine how the actual prototype will work, simulation is necessary at design stage where a model of the actual equipment is made. Dependent parameters, for instance, are then put on the model to mimic the performance of the actual system/ prototype (Ogbonnaya, 2004).

5.0 NONE SOFT WARE RELATED PUBLICATIONS

1. Application of Torsional Vibration (TV) in System Maintenance; was used to show how TV analysis can be used to highlight the state engine health (Ogbonnya, 2006).

2. While Investigating and identifying the problems resulting in the causes of scale deposits in the oil fields of Niger Delta, Ukpaka and Ogbonnaya, (2011) showed how useful it is to predict, identify and monitor the problem of scale formation in oil fields. The authors thus concluded that detecting the onset of scale firm is of immense benefits to operators of oil and gas industries.

3. In Nwankwojike, et al (2012a), where integrated ventilation comprising a dilution and local exhaust systems was designed to remove heat and contaminants from the mechanical engineering training workshop of Michael Okpara University of Agriculture Umuahia. The project also includes conditioning its indoor air temperature to ensure thermal comfort of the occupants.

An analysis of this design is that ventilation system will provide a comfortable, healthy working environment for the workshop occupants and also improve the functionality of training maintenance and equipment therein.

4. The importance of heat exchangers in the running and maintenance of machinery cannot be over – emphasised. This led Prof Ogbonnaya and other researchers to conduct project on how to take care of these equipment while looking at fouling. The recorded results of the work show that high pressure water-jetting method is the best approach for combating fouling for performance recovery.

5. In Ogbonnaya, et al (2010),the relationship between capacity building and technology development was looked at in paper titled Capacity building was identified as being neglected in the manufacturing sector of Nigeria's economy. The paper therefore promulgated the adverse effect of such neglect after enunciating the ingredients of capacity building. Also highlighted are some of parameter that militate against technology development due to lack of capacity building. The work ended with many useful methodological recommendations.

6. In Fadeyi, et al (2013), where a study was carried out showing how to reduce production down-time significantly, thereby optimizing the machine time and consequently, raising the reliability of the production system. This method was carried out in a firm that

produces sanitary towel and babies' disposable towel with high production down-time.

7. In Ogbonnaya, et al (2013), where the influence of Neem leave extract on the corrosion inhibition of mild steel (MS) in a chloride medium was investigated. The research was carried out by immersing as-received and heat treated MS coupons in salt water with various concentrations of Neem leave extract ranging from 0-20%. Method of investigation was gravimetric, based on weight loss of coupons in the different solutions. The results shown in figures 5.1 and 5.2 shows that MS samples immersed in salt without Neem leave extract exhibited a much higher weight loss as compared to those with Neem leave extract.

8. In Ogbonnaya, et al (2010), factors that could revitalize a nation during economic recession were highlighted. Features, effects of economic meltdown with how to counteract them were looked at, and adequate recommendations made. According to II Sam. 21:1, the famine in the land of Israel lingered for 3 whole years until David sought the face of the Lord. He prayed and the Lord showed him the way out of the severe vibration/ regression/ famine, the Israelites were then going through – "that it is for Saul and his house.....". Nigerians, we need to pray harder and more to overcome a high vibration we are going through in this country. Imagine in this our University; we go for Senate without praying. In AKSU, where I am on sabbatical they even sing hymn before senate meeting. I am so happy that we prayed extensively for this occasion.

9. Also in Ogbonnaya (2006), it was shown that lack of appropriate manpower development adversely affects capacity building in Nigeria's economy.

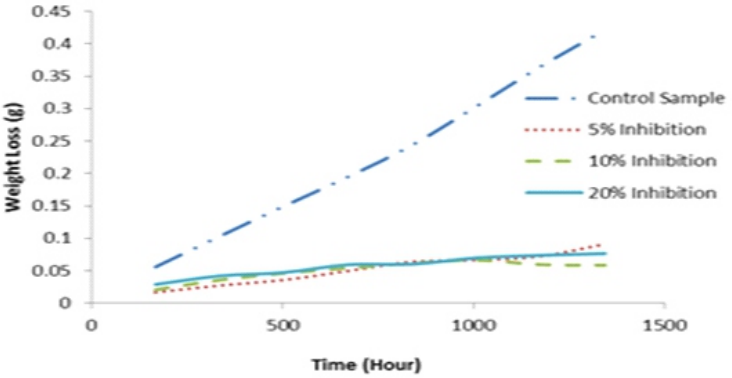

Fig 5.1: Weight loss versus time for sample in the corrosive medium with 100% of inhibitor

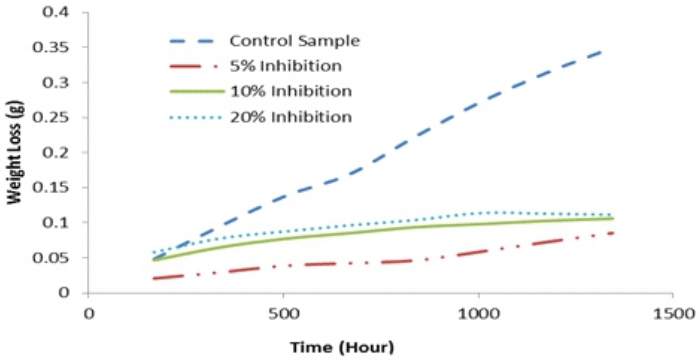

Fig 5.2: Weight loss versus time for heat –treated coupons.

10. In programming, the power of a mathematical technique was also looked at using the mechanical energy consumption of a palm nut pulp separator (Nwankwojike, et al, 2012b). The work showed that implementation of power and energy needs a lot of optimization.

6.0 WORKS IN FAVOUR OF NIGER DELTA

1. In Ukpaka, et al (2010), where a mathematical model was developed to evaluate the performance and cooling tower characteristics as well as water to air flow ratio using the Merkel equation to demonstrate the best approach in evaluating cooling water characteristics. Furthermore the result obtained showed that the actual amount of water evaporated depends of the effectiveness of the mass refer (efficiency of air-water contact, area of contact, distribution etc.)

2. In Poku and Ogbonnaya (2014), it was shown that the introduction of an evaporative cooler would help to improve the performance (ŋ), compressor and turbine efficiencies, of GT plants operating in the Niger Delta Region. The Immuring GT plant was used to actualize this project and is already adopted by the operators in that area.

3. Also in Poku, et al (2015), it was further shown using the same Immuring Rolls-Royce, Industrial Olympus-SK 30 GT engine the reduction of inlet temperature using an evaporative cooling technique improved the power gain tremendously. Permit it to be stated that these techniques were effectively turned over to the thermal station.

4. Coupling of Oil Analysis with VM: Ogbonnaya has helped the manufacturing sector of Nigerian economy to show that incorporating infra-red oil analysis and vibration measurement in condition monitoring is an effective method to prevent downtime, (Ogbonnaya, 2001). In Ogbonnaya (2000), a paper was presented to the Faculty of Joint Services of Command and Staff College where it was suggested on the ship mix to be offshore resources. No doubt this work contributed to improve the roles of the Nigerian Navy (NN) today.

7.0 WORKS ON SHIP DESIGN AND CONSTRUCTION

1. In Tamunodukobipi, et al (2009), a computer-based analytical mode was used to show that the variation of performance parameters and their characteristic contours are critical to determine what happens to small crafts during transition from bow wetting to full planning.

2. From McRae et al (1984), a mooring buoy tender for servicing the chain on Royal Naval Engineering College, Manadon-Plymouth pleasure boats was designed, constructed and tested. This Design and Make work won the George Stephenson's award for that year.

3. Ishiodu, et al (2013) where Bernoulli's principles and Newton's Third law were combined to come up with how an unusual 4-bladed propeller could be designed. The specific interest is for vessels with 85BHP and speed of 30knots for a fixed pitch propeller.

4. In Nitonye and Ogbonnaya (2013), the basic consideration of strength and stiffness on ship design structure was shown to include factor of safety, cost, weight, shock, vibration, fatigue, corrosion, fabrication and maintenance. With the size of barge taken, it could be seen that this is an unusually large size which needs careful considerations. Hence, the importance of this type of vessel in the Oil and Gas industry. The paper was presented in SNAME Ship Production Symposium -2013 in Seattle, Washington US.

5. The presentation during (SNAME) AGM/congress in Houston-Texas, USA, where it was shown that conversion of VLCC to FPSO is more economical than the building of new one due to the reduced lead time. A number of vivid and valid ship construction steps were considered using a computerized model to actualize the procedure. Analysis reveal that the block coefficient (C_B) yields an important result that if put into consideration during the design phases of FPSO-be it new build or converted will go a good way to aid the building process. Two FPSOs-BONGA (new build) and MYSTRA (converted) were used as case studies. The C_B of the new build was found to be 0.7202 while the converted was 0.690 with sponsoon and 0.818 without sponsoon. Results obtained from the analysis further revealed that incorporating sponsoons provide sufficient rigidity and good stability characteristics under all operating conditions (Ogbonnaya et al, 2014). Typical diagrams of the different types of FPSOs visited while working on the project are shown in figures 7.1 to 7.5.

Fig 7.1: FPSO MYSTRAS

Fig 7.2: FPSO BONGA

Fig 7.3: VLCCs to be converted to FPSOs

Fig 7.4: VLCC

Fig7.5: VLCC converted.

6. In the design for the 5000T work-barge detailed in 3 above. If executed adequate stability analysis, then calamity could easily set in. That is why catastrophic the work on, Nitonye, et al (2013)

   Where the determination of optimal scantling to ensure good stability characteristic, estimation of the

principal dimensions and stability of the work-barge when the crane is in operation were carried out using the hydrostatic curve of the vessel for safe operations.

7. Presently Ogbonnaya is involved in an international project involving the Design and Building of a six-man Airboat in collaboration with Korea Institute of Science and Technology (KIST) Alumni body. This construction is being headed by an ex-KIST Marine Engineer presently lecturing in RSUST. The Airboat is shown in fig 7.6 and 7.7 below.

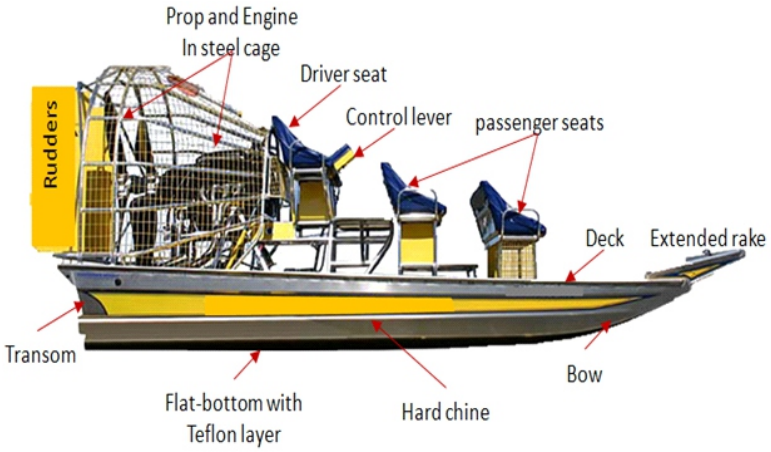

Fig 7.6: Airboat and description of principal features

Fig 7.7: Back view of the airboat

Tables 7.1 and 7.2 are specifications for a new build and converted FPSO respectively.

FPSO BONGA- SPECIFICATION (NEW BUILD)	
Key Data	
Operator	Shell
Shipbuilder	Samsung
Type	FPSO
Operating depth	1,000m to 1,125m of water
Length	305.1m
Length bp	295m
Moulded breadth	58m
Design draught	23.4m
Scantling draught	23.9m
Topside processing system	22,000t
Process capacity	225,000 barrels of oil per day
Tank temperature	60˚C
Export rate	7,000m^3/hr (1million barrels per 24 hrs)
Mooring lines	12 (four groups of three mooring legs)
Storage capacity	225,233m^3 or 2million barrels
Volume displacement	298,220m^3
Gas export facility	150million standard cubic feet per day
Diesel	10,970m^3
Water ballast	138,131m^3
Double skin	5.4m
Block coefficient	0.7202
Officers	4
Crew	66
Rooms	4 single and 33 double rooms
Alternators	2
Capacity	1,900kW at 1,000rev/min
Make	Wartsila / AMG 630 S6 ABB
Carbon tanks	15
Pumps	15 hydraulic submersible
Make	Framo
Capacity	1,500m^3per hour
Cargo and ballast control	Nakakita Siesa Kusho
Lifeboats	Five 50-percent, totally enclosed lifeboats
Classified	
Notation	+ 180 floating production and offloading installation +OMC OIWS,IGS,CAAO,SBT,PL,CCCS,LI,SHIP, Right (SDA,FDC,CM,PCWBT) Helicopter Deck

Table 7.2: Specifications of a VLCC Converted to FPSO

FPSO MYSTRAS-SPECIFICATION (CONVERTED)	
Key Data	
Operator	Agip Energy Nig. Ltd
Shipbuilder	Mitsui shipbuilding & Engineering Co. Ltd.
Class Type	Lloyd's Register of Shipping FPSO
Operating depth	70m of water
Length overall	271.000m
Length between perpendiculars	260.000m
Moulded breath	44.00m (excluding sponsons)
Moulded breath	55.400m (including sponsons)
Depth moulded	22.400m (main deck)
Depth moulded	22.061m (sponsons)
Process capacity	100,000 barrels of oil per day
Draft at summer load line	17.021m
Keel plate thickness	26.50mm
Mooring lines	12 (four group of three mooring legs)
Storage capacity	162,117m^3 or 1million barrels
Dead weight	138,930ton
Block coefficient	0.818 (excl. sponson)
Block coefficient	0.690 (incl. sponson)
Design speed	15 knots

8.0 ENHANCEMENT OF OPERATIONS IN THE MARITIME INDUSTRY

Specifically under this area are the following works:

1. Reduction of exhaust pollution at sea from watercraft. In other to keep on the important agenda of sustainability which has lately become an issue of priority, the maritime industry must implement technologies on existing vessels and on those under construction so as to reduce their emissions into the environment. This study examines three potential sources of emission and also identifies a set of emission control measures that are available and could, if fully applied, reduce emission by 19.058%. With the waste heat recovery system, about 2500 KW of energy is saved, thereby increasing the efficiency to 59.11% having about 10.13% gain compared to engines without a waste heat recovery system. It is therefore recommended that the use of waste heat recovery systems should be encouraged on marine vessels to reduce the impact of noxious gases into the atmosphere (Ogbonnaya, et al, 2013a).

2. How to improve transportation system especially the marine aspect in Nigeria: Where the promulgation of steps to prevent marine accidents were seen as one of the most major steps to enhance effective marine transportation in Nigeria. Our waterways also need to be effectively policed to prevent sea piracy.

3. The engines used for marine propulsion and electricity generation need to be properly simulated and modelled at design stages. These points are well expatiated in Ogbonnaya (2010), where software code-named DEPERS meaning Diesel Engine Performance Simulator written in MATLAB Programming Language was used to actualize the work for all the engine cycles.

4. A systematic and methodological work was carried out to bring out the developmental advances in propulsion system control. These stages are published in Ogbonnaya (2010). In that work, it was identified that the use of cyclo-converters with fibre-optic medium in Combination of Diesel Electric and Gas (CODLAG) vessels is the best alternative for future marine engineering applications (Ogbonnaya and Koumako, 2006).

Furthermore, the recommendations from this work are as follows;

a. Automatic (recycling) type of control system for steam ships as against the non-recycling type of burner should be adopted.

b. The issue of shaft vibration monitoring in propulsion system control should be given more attention

c. The use of fibre-optics as a control medium for propulsion systems should be exploited

d.Cyclo-converter using electric propulsion drives for

CODLAG as main propulsion engine should be encouraged.

e. An ultimate integrated continuous monitoring system should be adopted

f. The centralized control room monitoring system should be introduced for marine vessels.

g A micro-processor based approach of the above systems should be considered.

5. Pipeline monitoring activities is an important aspect of mechanical/marine engineer's contribution to human endeavour. That is why Ogbonnaya joined hands with other renowned researchers in Michael Okpara University of Agriculture, Umudike to design a facility to detect the faulty and number of the systems with the attention of the operator drawn through an alert in order to rectify the problem. Also embedded is a cell-phone in the pipeline, which alerts an administrator when any part of the line is tampered with by triggering an attached alarm for aural effects. Furthermore, the Information and Communication Technology-Based model if properly applied and operated, serves as a control and panacea for nipping in the bud the activities leading to pipeline leakages and associated ruptures due to corrosion and asperities.

9.0 OTHER MINOR PRODUCTIVE WORKS

1. The setback which the perennial and lingering constant power is wielding on the Nigerian economy has also been addressed (Ugwu, et al, 2012b). This work was followed up with solution to the nation's constant power/energy outages. From the study, it was noticed that self-generation of electricity was not in any way cost effective, despite the type of fuel being used. The recommendation from the report is therefore that the results be taken as a challenge by the concerned governmental organs to achieve sustainable electricity supply from the national grid.

2. Ogbonnaya was in a team that researched on the effect of welfare programme in the Nigerian Armed Forces. The team, after looking at the constitutional responsibility of the Nigerian Armed Forces, as dictated by their role in the 1999 Constitution of the FRN came up with the facts that effective training, relevant equipment and facilities have to be provided with a conducive motivating atmosphere for higher productivity and enhancing professionalism (Okiti, et al, 2000).

3. The derivable benefits from the immense offshore resources are dependent on how well aggressors are kept away from the sea space. It is in the light of this that a research was ordered in 2000 to examine some of the likely threats to Nigeria's offshore assets. Based on that examination, the NN was identified as d best force to protect Nigeria's sea assets (Ogbonnaya, 2000).

In the course of the research, it was discovered that the NN is ill-equipped to protect the immense offshore pelagic resources of Nigeria. Various options to effectively protect these assets were considered. The best option of establishing an Offshore Patrol Squadron (OPS) was then recommended. Other recommendations towards implementing the OPS were finally made (Ogbonnaya, 2000). Today these recommendations have been adopted, and are paying off.

It is pertinent to note that in consonance with the result of this research, the NN now has several Forward Operational Bases and a modernised mixture of ships in her fleet. Furthermore an additional work was carried out to specifically propound measures to protect the oil rigs of which Ogbonnaya equally effectively participated in (Arfo, et al, 2000).

4. Ogbonnaya attended numerous effective trainings as a naval officer. Fig. 9.1 show's a snap shot taken during one of his training in Kebbi State as he was examining the stars with a binoculars.

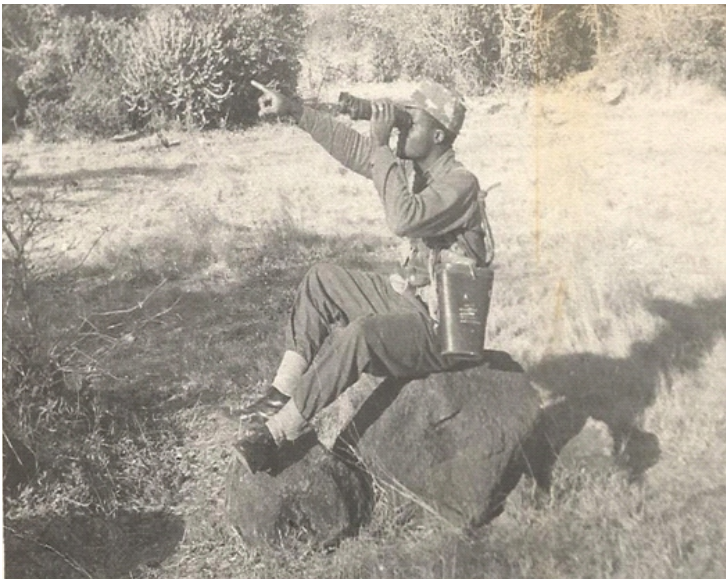

Fig 9.1: Picture taken while examining the stars in Kebbi State.

1. Ogbonnaya was at the head of the 20 military officers research team that visited Kebbi State in 2000 to study causes and how to avert environmental degradation in that state (Ogbonnaya, et al, 2000). Most of the recommendations made as a result of the research are already implemented and are also paying off. Shown in fig 9.2 is a snap shot of the military research team at one of the sand dunes in Kebbi State.

Fig 9.2: Military Research Team to Kebbi State - Nigeria

1. The experience gained by Ogbonnaya during his Naval service and working on various types of refrigeration and air conditioning systems was brought to bear when he joined hand with Engr.Ugwu to design and adapt a commercial cold storage facility for Umudike community in 2012 (Ugwu and Ogbonnaya, 2012).

10.0 BOOK CONTRIBUTIONS

1. Ogbonnaya, E.A (2004), Thermodynamics of Steam and Gas Turbines, Orus Press Ltd, Port Harcourt, Nigeria, ISBN:978-2631-760

2. Ogbonnaya, E.A and Koumako, K.E.E (2006), Basic Automatic Control, King Jovic International, ISBN: 978-26214-0-7, Port Harcourt, Nigeria.

3. Ogbonnaya, E.A (2008), Technical and Engineering Drawing, ISBN: 978-38214-1-5 by Gem Production.com, Port Harcourt, Nigeria.

4. Ogbonnaya, E.A (2009), Conventional Engineering Drawing, Published by Mint Slaught Ventures, #1 Nnewi St. Mile 1 Diobu, Port Harcourt. ISBN: 978-382141-1-5.

Front cover pages of these books are shown on the back cover page of this Inaugural Lecture booklet.

11.0 PROFESSIONAL DEVELOPMENT

- Delegate, Nigeria Oil and Gas Trade September 2012, Oil and Gas Free and Investment Forum , Zone, Onne, Rivers State, Nigeria
- ASME/IGTI CONFERENCE, June, 2012, Copenhagen, Denmark
- NIMechE (A Division of NSE) Conference, Oct, 2010, Port Harcourt, Nigeria
- METOCEAN AWARENESS COURSE, Sep, 2010, London, UK. IMarEST

- SUBSEA AWARENESS COURSE, SOCIETY, Aug, 2010, Lagos, Nigeria FOR UNDERWATER TECHNOLOGY, SUB-SAHARAN BRANCH
- ASME/IGTI CONFERENCE, June, 2010, Glasgow-Scotland
- ASME/IGTI CONFERENCE, 2009, Florida, USA
- SMENA CONFERENCE, 2008, RSUST, Nigeria
- MICROSOFT OFFICE SUITE AND VISUAL BASIC COMPUTER PROGRAMMING LANGUAGE, 2003, Port Harcourt, Nigeria
- MANAGEMENT COURSE (IN AFFILIATION WITH ABUCONSULT), 1999 CSC, Jaji, Nigeria
- COMPUTER APPRECIATION: APPLICATION INCLUDING MS DOS, AutoCAD AND QBASIC, 1997, SOMI Technologies Nig Ltd, Port Harcourt
- SEVERAL COREN ANNUAL CONFERENCES AND AGM, 1994-Date Nigeria
- SEVERAL NSE ANNUAL CONFERENCES AND AGM, 1992, Nigeria
- NAVAL NUCLEAR BIOLOGICAL AND DAMAGE CONTROL (NBCD) INCLUDING FIRE FIGHTING COURSE, 1984, HMS SULTAN, U.K
- NBCD AND FIRE FIGHTING COURSE, 1974, INS SHIVAJI, India

12.0 DESIGN PROJECTS

- Consultancy for Chevron/Naval Shipyard Project to Design and Fabricate Tyre Fenders' for Chevron Nigeria Ltd., 2010.
- Refublishment of Umu-Imenyi Palm Oil Mill Boiler, Safety Valve and Piping System, 2005, 2006/2007.
- Major Overhaul of 1MW Wireless Shore-Ship Diesel Electricity Generator on FSG(West), Apapa – Lagos.
- Design, Construction, Fixing and Testing of Tank Content Gauge for Shore-Ship Power House Fuel Tank in FSG(W), 1994.
- Supervision of the Design, Construction and Testing of 250,000litres Overhead Water Tank on NNS KAMANU, Owerrinta – Abia State (with associated pipings and fittings), 1991.
- Design, Construction / Fabrication, and Testing of a 'Shaft Locking Gear' for NNS DAMISA, 1990.
- Supervision of the Overhaul of a 250KW MTU 12VTS Electricity Generator on Board NNS ERIN-OMI, 1989.
- Major Overhaul of MWM 120KVA Electricity Generator on NNS DAMISA, 1988.
- Design, Construction and Testing of a Laboratory for Measurement of Water Stream, BSc (Mechanical Engineering Project) UNICEF, 1984.

13.0 ADMINISTRATIVE AND SPECIAL POSITIONS HELD IN ACADEMICS

- Director, Niger Delta University/ Nigerian Maritime Administration and Safety Agency Institute of Maritime Studies, Wilberforce Island, Yenagoa, Bayelsa State, Nigeria. (2015).
- Professor, Department of Marine/Mechanical Engineering, Niger Delta University, Wilberforce Island, Bayelsa State. P.M.B 071, Yenagoa, Bayelsa State, Nigeria. (2014).
- Co-Ordinator of Niger Delta University/ Nigeria Chamber of Shipping Transport, Oil and Gas Post Graduate Diploma and Certificate Programmes. P.M.B 071, Yenagoa, Bayelsa State, Nigeria. (2014).
- Head, Department of Marine/Mechanical Engineering, Niger Delta University, Wilberforce Island, Bayelsa State. P.M.B 071, Yenagoa, Bayelsa State, Nigeria. (2014).
- External Examiner, Department of Marine Engineering of Federal University of Petroleum Resources, Effurun, Warri, Delta State. (2014).
- Visiting Professor, Department of Marine Engineering, Akwa Ibom State University Ikot Akpaden, Mkpat Enin LGA, P.M.B 1167, Uyo, Akwa Ibom State, Nigeria.

- External Examiner, Marine Engineering, Ship and Boat Building, 2010/2011 Academic Session, Delta State School of Marine Technology, Burutu, P.M.B 1060 Warri, Vide Letter Reference: DESOMATEC/REG/ADMIN/APPT/16, dated 13th March 2012.
- Adjunct Professor, Department of Maritime Engineering, Maritime Academy of Nigeria, Oron. 2011 till Date
- External Assessor, Nigerian Journal of Maritime Engineering (ISSN: 1595-0506) a Publication of School of Marine Engineering, Maritime Academy of Nigeria, P.M.B. 1089,Oron-Akwa Ibom State, Nigeria (2010 till date).
- Ag. Head, Department of Mechanical Engineering, Michael Okpara University of Agriculture, Umuahia, 01 September 2011-2012.
- Chairman, LOC, International Conference on Children-in-Science-and-Technology for the attainment of Millenium Development Goals, held in RSUST Amphi-Theatre, 02-04 November 2010.
- Ag. Head, Department of Marine Engineering, RSUST, Port Harcourt, March 2009-2011.
- External Moderator, ND/HND Programme of Marine Engineering/Boat/Ship Building Technology (2008-Date) Maritime Academy of Nigeria, Oron.

- Associate Editor, Journal of Research in Engineering (See Journal of Engineering Vol. 3 No.1, 2006), 2006 – Date.
- Ag. Head, Department of Mechanical Engineering, Michael Okpara University of Agriculture, Umudike, Umuahia, 2005-2008
- Part-Time Lecturer, Department of Marine Engineering, Niger Delta University, Wilber Force Island, Amasoma, Bayelsa State. 2005-2006.
- Faculty of Engineering(FE) Exam Officer, RSUST, Port Harcourt, 2005.
- Deputy President, Science & Technology Forum and Assessor to Int'l Research & Development Network, June 2005 – Date.
- Secretary, FE PG/ Seminar Committee, RSUST, PH, 2004 – 2005.
- Assessor to NBTE Journal, Nigerian Journal of Technical Education (2002-Date).
- Chairman, Technical Session, Conference on Manufacturing Processes, Community Hall, University of Uyo, March 2001.
- Chairman, Examination Malpractice Committee, NDA Kaduna 2000 – 2001 Academic Session.
- Chairman, NSE Technical Session, Annual General Meeting in Port Harcourt December 2001.

14.0 COMMUNITY SERVICES

Prof Ogbonnaya is involved in the community services listed below:

- Patron, Oganiru Progressive Club of Nigeria, Port Harcourt Branch.
- Consultant to Transparent Earth Nigeria Ltd. Rivers State, 2009-Date.
- Consultant to Brain Box Matrix Services Ltd., 11 UST Road, Port Harcourt, 2009.
- Consultant to Umu-Imenyi Oil Palm Mill, Akoli-Imenyi, Abia State, 2008.
- Consultant to Nigerian Naval Shipyard, Reclamation Road, Port Harcourt , 2005-Date.
- Technical Consultant to Motherless Babies Home, Lohum, Bende LGA, Abia State 2005-Date.

15.0 AWARDS

The awards received by Prof Ogbonnaya are as follows:

- Meritorious Service Star (mss 2000)
- Passed Senior Staff Course (CSC, Jaji, 2000)
- NSE Presidential Award For Excellence (1999)
- Passed Junior Staff Course (CSC, Jaji, 1991)
- George Stevenson's Best Design And Make Project (RNEC, Manadon, UK, 1984)
- Forces Service Star (fss) 1984

16.0 RECOGNITIONS

Despite vibrations of life, Ogbonnaya, as a person (not to talk of his works) has been recognised everywhere he went. Appendix F is a Letter of Congratulations from the Chief of Naval Staff – Vice Admiral I.E. Abbas. Also Appendix G is a Letter of Commendation from the Vice-Chancellor of NDU, to Prof Ogbonnaya as a result of his developmental strides in NDU. Suffice it to state at this juncture that Ogbonnaya is on Sabbatical leave to the Department of Marine Engineering, AKSU. Barely a week after joining AKSU, he got another Appointment letter to join Federal University of Petroleum Resource Effurun on sabbatical too. Are all these not because, to quote Prof F.B. Sigalo (2017), "...you are a very marketable product...".

17.0 MEMBERSHIP OF PROFESSIONAL BODIES

Prof Ogbonnaya is a member of the professional bodies listed below:

- Member, Society of Marine Engineers and Naval Architects (MSMENA)
- Fellow, Institute of Marine Engineering Science and Technology (FIMarEST), #056074, 2010
- Member, Society of Naval Architects and Marine Engineers (MSNAME), #9276 2002
- Member, American Society of Mechanical Engineers (MASME), #9755489, 1998

- Council of Regulation of Engineering in Nigeria (COREN), R. 9535, 1995
- Chartered Engineer (CEngr), #466816 , 1995
- Member, Nigerian Society of Engineers (MNSE), #06034, 1993
- Licentiateship Indian Society of Engineers (LISE), #518, 1975

18.0 CONCLUSION

The immense contributions of Prof Ogbonnaya to humanity, engineering especially Marine Engineering and Naval Architecture have been highlighted through this lecture. It has also been shown that Prof Ogbonnaya is versatile in human endeavours. He has introduced a lot of feats as a boiler, diesel, capacity building, control, diagnostic instrumentation and environmental engineer, to mention but a few.

He is a thermo-dynamist, energy and power engineer. He has great acumen for engineering drawing and design. In the area of ship construction, he is not left out. Generally speaking, he is a universal engineer who has placed NDU on a global map of achievements. There is no doubt why the authorities of NDU made him the first Director of the Nigerian Maritime Administrative and Safety Agency sponsored Institute of Maritime Studies.

Having passed through the naval service, he is well-disciplined and respectful. He also is a disciplinarian. He did not desert from the Navy as he honourably resigned from that service to fully face academics. He is a great

mentor. He does not believe in bad belly, gossips, or currying favour.

He has a very stable family background, married to Mrs Florence Udeaku Ogbonnaya (Nee Onyecherelam). He is a Daddy, Grandpa and Big Daddy being blessed with children and grandkids.
Ogbonnaya is however not like the lizard that fell from the top of the iroko tree, looked right, looked left and applauded itself. He is a very humble man who believes in hard work and that the reward for hard work is harder work. I hereinafter do not know what more to say as a person, other than to

19.0 RECOMMENDATIONS

The recommendations are as follows:

a. People should not see being vibrated as an adverse issue.

b. Vibration, as an important component of human life, should happen to human beings (just like in machines) once in a while as long as they are alive.

c. Vibration should be used proactively in life, for maintenance of human systems.

d. Engineers should learn to diversify, irrespective of their areas of initial specialization.

e. The uses of engineering software and simulation should always be exploited in solving technical oriented problems.

f. We should consider our bodies and systems more than we do for machines, components and systems to avoid catastrophe.

g. To overcome the present technological/economic meltdown/recession vibrating NDU, the State, and Nigeria generally, the University should pray harder in more meeting arena.

CHORUSES:

- We are Saying Thank You Jesus
- We Thank You, O Lord, Thank You God, Thank You Father
- For Everything You have done.

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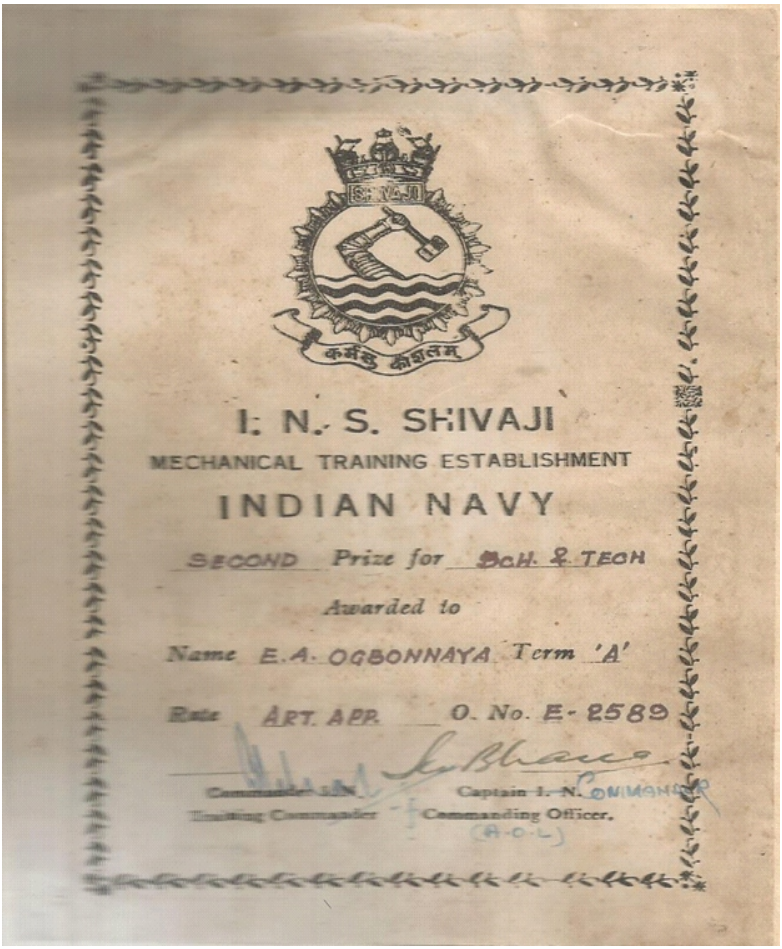
APPENDIX A:
EVIDENCE OF PRIZE WON DURING APPRENTICESHIP TRAINING IN INDIA.



I. N. S. SHIVAJI

MECHANICAL TRAINING ESTABLISHMENT

INDIAN NAVY

SECOND Prize for BoH. & TECH

Awarded to

Name E.A. OGBONNAYA Term 'A'

Rate ART. APP. O. No. E-2589

Commander I.N.
Training Commander

Captain I. N.
Commanding Officer.

(A.O.L.)

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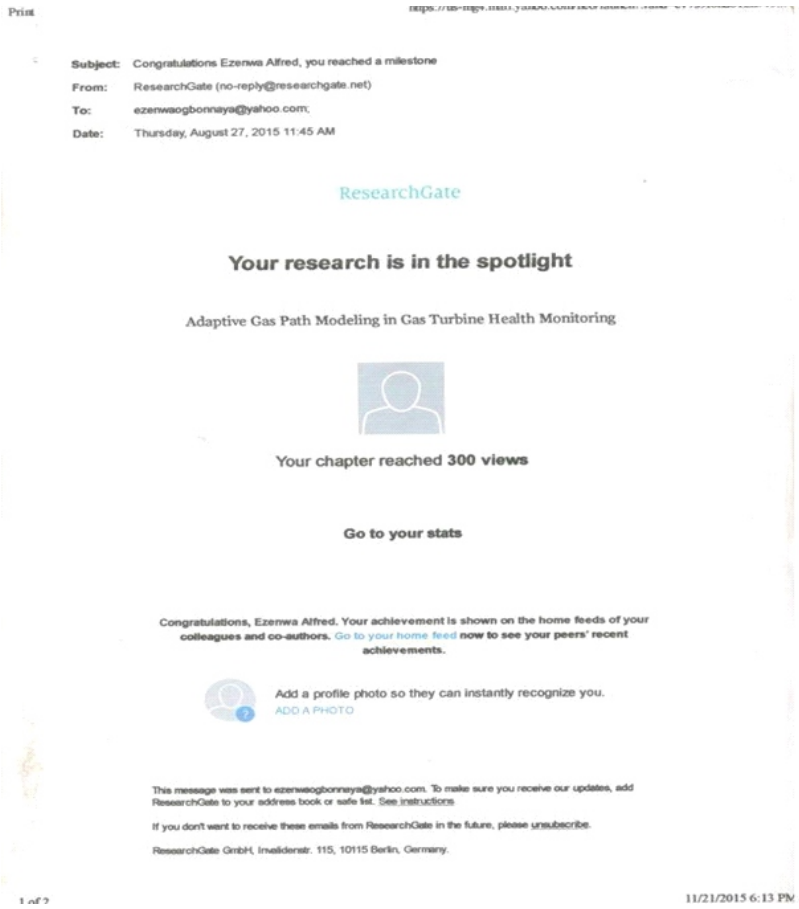
A PUBLICATION WITH 300 DOWNLOADS AS AT THURSDAY, AUGUST 27, 2015.



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1 of 2 11/21/2015 6:13 PM

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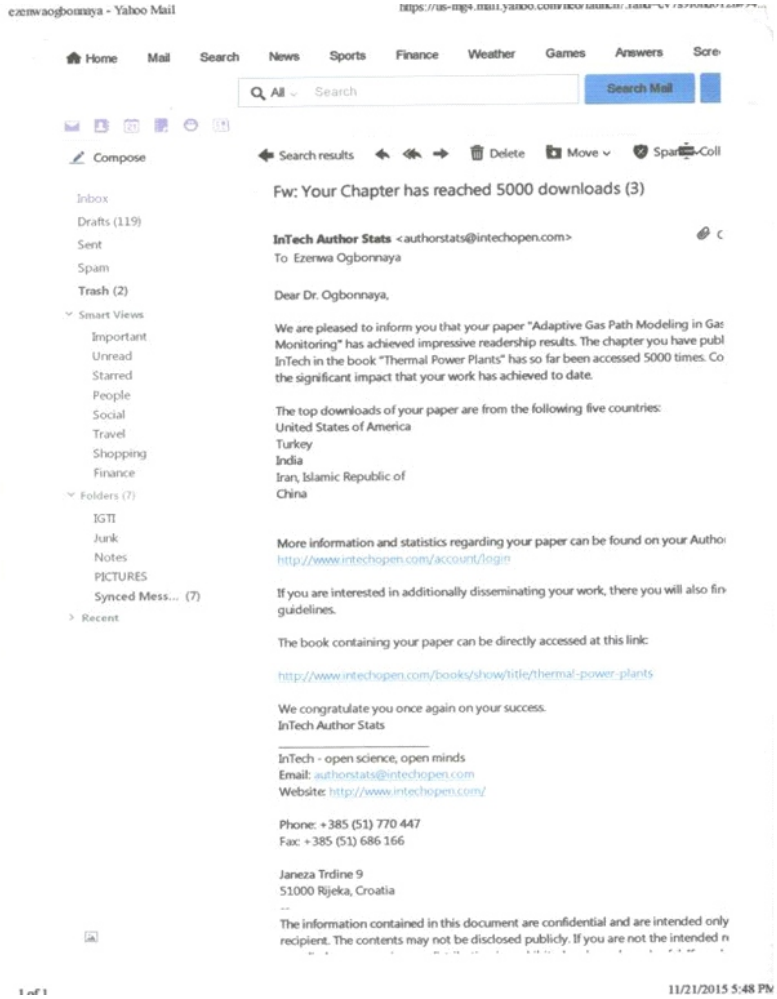

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Your research is in the spotlight

Analysis of Gas Turbine Blade Vibration Due to Random Excitation

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APPENDIX E:
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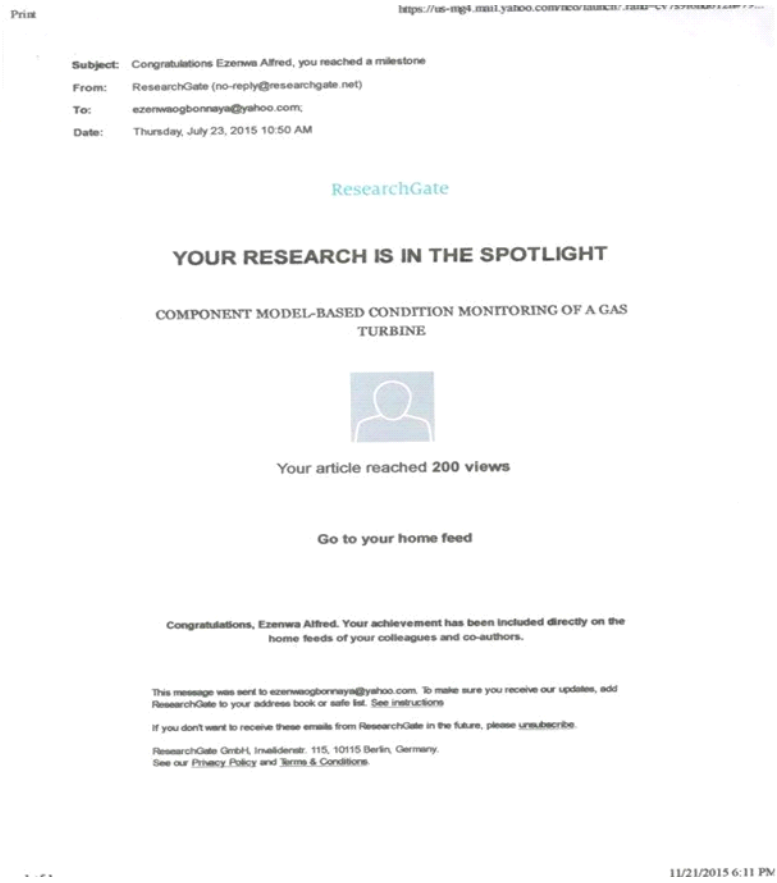

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APPENDIX F:
A SPECIAL LETTER OF CONGRATULATION FROM THE CHIEF OF NAVAL STAFF

RESTRICTED

OFFICE OF THE CHIEF OF THE NAVAL STAFF

Reply should be addressed to:
The Chief of the Naval Staff
Nigerian Navy

Naval Headquarters
Ministry of Defence
Area 7, Garki
Abuja, Nigeria
Email: nacns@navy.mil.ng
cnssec@navy.mil.ng
Tel: +234 8117777701-8
Ext: 106 and 179

Ref: NHQ 020/125/97/Vol.VI/ 35/

Cdr (Engr Prof) EA Ogbonnaya (Rtd)
Head of Department of Marine Engineering
Niger Delta University
Amassoma
Yenagoa
BAYELSA STATE

12 February 2016

Dear Prof,

LETTER OF CONGRATULATIONS

1. It was with much delight and deep sense of pride that I received the news of your promotion to the professorial grade in the academia. The entire Nigerian Navy community joins me in congratulating you on your attainment of this enviable feat. This tremendous milestone is a testimony of your enduring hard work, doggedness and dedication to duty.

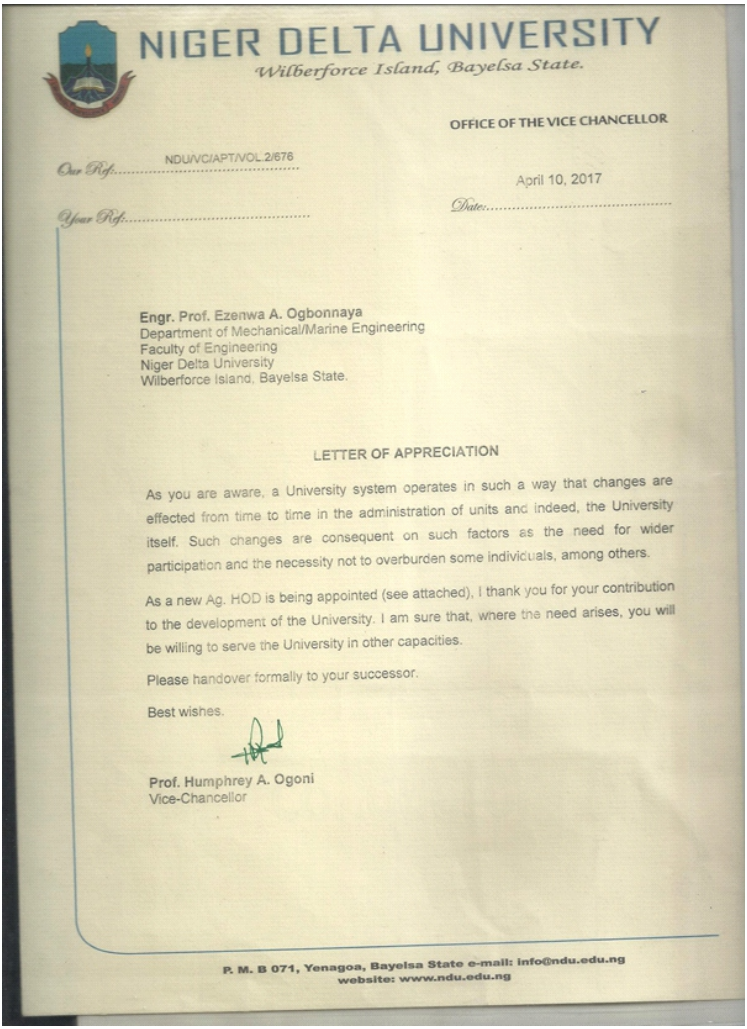
2. Your achievement has come as no surprise to us considering your commitment to duty and perseverance in academical self development while in service. You are indeed a shining example for others to emulate and we are very proud of you. Permit me however to still remind you that as lofty as your attainment may be now, it is as you well know, never the limit. I therefore urge you to set new frontiers for yourself and draw from this accomplishment to further surpass them.

3. Please my dear Professor, accept my best wishes for continued success and fulfillment of all your set goals in the years to come. Once again congratulations.

IE IBAS
Vice Admiral
Chief of the Naval Staff

-Unauthorized Disclosure of Information on this Sheet is Unpatriotic and Against the Official Secret Act-
RESTRICTED

APPENDIX G:
LETTER OF COMMENDATION FROM THE VC NDU



NIGER DELTA UNIVERSITY
Wilberforce Island, Bayelsa State.

OFFICE OF THE VICE CHANCELLOR

Our Ref. NDU/VC/APT/VOL.2/676

Your Ref.

Date: April 10, 2017

Engr. Prof. Ezenwa A. Ogbonnaya
Department of Mechanical/Marine Engineering
Faculty of Engineering
Niger Delta University
Wilberforce Island, Bayelsa State.

LETTER OF APPRECIATION

As you are aware, a University system operates in such a way that changes are effected from time to time in the administration of units and indeed, the University itself. Such changes are consequent on such factors as the need for wider participation and the necessity not to overburden some individuals, among others.

As a new Ag. HOD is being appointed (see attached), I thank you for your contribution to the development of the University. I am sure that, where the need arises, you will be willing to serve the University in other capacities.

Please handover formally to your successor.

Best wishes.

Prof. Humphrey A. Ogoni
Vice-Chancellor

P. M. B 071, Yenagoa, Bayelsa State e-mail: info@ndu.edu.ng
website: www.ndu.edu.ng

NIGER DELTA UNIVERSITY
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3	Engr. (Dr.) Dau S. Ziborkere	Post-Harvest Agricultural Processing: Lessons from the Honeybee	30-03-2011
4	Prof. Kingsley Danekete Alagoa	A Probe as a Predictive Tool: A Theoretical Physicist's Pathway (Plasma as a Model)	25-05-2011
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