FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

THE IMPORTANCE OF THE SMALL AND MEDIUM - SCALE INDUSTRIES IN NIGERIA

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B.Sc (London), M.Tech (Brunel, U.K), PhD (Brunel)
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INAUGURAL LECTURE SERIES 38

12TH NOVEMBER, 2015

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Professor of Mechanical Engineering

Unto the LORD be all the glory for He has done all things pertaining to my life so excellently well. Thanks be to the LORD ALMIGHTY!

Courtesies

The Vice-Chancellor,
Deputy Vice-Chancellors (Academic and Administration),
Registrar,
Other Principal Officers of the University,
Dean School of Engineering,
Deans of Other Schools and Postgraduate School,
Professors and other members of the Senate,
Head of the Department of Mechanical Engineering,
Head of Other Departments,
My Academic Colleagues,
The Congregation and Other Staff,
My Lords Spiritual,
My Special Guests, Friends and Well-Wishers,
Gentlemen of the Print and Electronic Media,
Great Futminnaites,
Ladies and Gentlemen.

It is by the Lord's grace that I stand before you today the 12th of November 2015 to present the 38th Inaugural Lecture of this University.

Introduction

When at creation God said, *"Let there be Light"*, and there was light, a chain of regenerative vibratory waves were set in motion, which are inexhaustible. Many marvelous and wonderful things came into existence of which the human being was the most

outstanding miracle of all. There was a release of power in the creation of things around us which no matter how hard engineers and scientists tried they cannot fully understand. The sensitive ones among us just knew that the sinusoidal waves set out at creation has never stopped propagating themselves. As a matter of fact, it has formed a "God's Cloud" of inventions into which the fortunate ones among us have ventured into occasionally and brought forth designs of machines and utilities. Today, many are of the belief that there is no invention that is new, but had once been produced. This is very likely since our God, the creator of all things had perfected all that man will need at creation and deposited all in "God's Cloud". We see a poor copy of this today in the "Computer Cloud", which is a universal data storage bank for every computer user, instead of the internal and external hard disc presently in use in the developed countries.

Therefore as a manufacturing (production) engineer, I have not been surprised at the inspiration that came in a vision or a flash before each machine I had designed and fabricated. I will mention some of these machines later which are specifically for medium and small scale industries, the area of my specialization.

Nigerian Industries

Since my area of specialization is in industrial production, I shall mention some pertinent information about Nigerian industries. The Nigerian Industries are clearly defined by the CBN into the category of Small, Medium and Large scale industries. There is at present no clear cut definition for Small, Medium and Large scaled industries in Nigeria. However, CBN in their N200b credit guarantee scheme defined industries as stated below:

A Small and Medium Scale Enterprise (SME) is an enterprise that has asset base (excluding land) of between N5million – N500

million and labour force of between 11 and 300. A broader definition that can be found in the archives of the CBN defines it as follows:

* **Micro/Cottage Industry**
  An industry with a labour size of not more than 10 workers, or total cost of not more than N1.50 million, including working capital but excluding cost of land.

* **Small-Scale Industry**
  An industry with a labour size of 11-100 workers or a total cost of not more thanN50 million, including working capital but excluding cost of land.

* **Medium Scale Industry**
  An industry with a labour size of between 101-300 workers or a total cost of over N50 million but not more than N200 million, including working capital but excluding cost of land.

* **Large Scale**
  An industry with a labour size of over 300 workers or a total cost of over N200 million, including working capital but excluding cost of land.

Industrial Production in Nigeria was seen to have increased by 0.18 percent in the fourth quarter of 2014 over the same quarter in the previous year. It averaged 2.37 percent from 2007 until 2014, when it reached an all time high of 9.35 percent in the fourth quarter of 2011 and a record low of -1.18 percent in the first quarter of 2009. Industrial production in Nigeria is quantified as the output of businesses from the sectors of manufacturing, mining and utilities. When the industries are graded from the largest by value of annual output to the smallest they rank as follows: crude oil, coal, tin, columbite; rubber

products, wood; hides and skins, textiles, cement and other construction materials, food products, footwear, chemicals, fertilizer, printing, ceramics, steel.

Nigeria Main Industry:

Oil and natural gas extraction and supply controls the **Nigerian industry sectors**. The oil sector generates about 30% of the GDP and accounts for 90% of the total export volume. The non-oil sectors are handicapped by lack of infrastructure and bad management. Before the mid 20s, Nigeria's industrial sectors were mostly engaged in agricultural production. Agriculture and mineral resources, other than crude oil drove the economy. However, the oil boom of the 1970s changed matters. The oil sector became the chief support of the economy. The government neglected agriculture and non-crude oil industrial sectors. Many people moved from the rural areas to the urban centers seeking employment and better living standard. Agriculture and the relating industries were neglected and there was massive unemployment. The oil and natural gas sector is the largest Nigeria industry. By the 2005 figures, it accounted for more than 90% of the annual national production and generated more than 80% of the government revenues. Nigeria produced 2.169 million barrels per day (2007 statistics). In terms of oil export volumes, the country ranked 8th in the world. The Nigerian National Oil Corporation (NNOC) regulates the Nigerian oil sector. It is a member of the Organization of Petroleum Exporting Countries (OPEC). Many reforms have been undertaken to improve the performance of the oil sector and many more are yet to be implemented. In order to pursue a long-term development, the government has to strategically plan to improve the non-oil industries in the nation.

Other Industrial Sectors in Nigeria are:

Mining: - Beside the non-crude oil sector, Nigeria has significant reserves of other minerals like coal, iron, gold, uranium and tantalum. The manufacturing, construction and chemical sectors are also showing improvement after the 2005 economic reforms.

Telecommunication: - Following the economic reforms of 2005, new emphasis were laid on improving the telecommunication sector. The Nigeria Communications Commission was given the responsibility to develop the mobile and internet communication systems in the country.

Nigeria GDP 1960-2015

The Gross Domestic Product (GDP) in Nigeria was worth 568.51 billion US dollars in 2014, which represents 0.92 percent of the world economy. The lowest record of GDP for Nigeria was 4.20 Billion USD in 1960, but reached an all time high of 568.51 Billion USD in 2014.

Actual	Previous	Highest	Lowest	Dates	Unit	Frequency
568.51	514.97	568.51	4.20	1960 – 2014	USD Billion	Yearly

The gross domestic product (GDP) is defined as the total expenditures for all final goods and services produced within the country in a stipulated period of time. Table 1 provides the latest reported value between 1960-2014 for Nigeria GDP, GDP annual growth rate, and at constant prices, GDP per capita, gross fixed capita formation, GDP per capita PPP, GDP contribution of all the industrial sectors and utilities. Content for - Nigeria GDP - was last refreshed on Wednesday, September2, 2015.

Table 1: GDP of Nigeria and Industries between 1960-2014

Nigeria GDP	Last	Previous	Highest	Lowest	Unit	
GDP	568.51	514.97	568.51	4.20	USD Billion	[+]
GDP Growth Rate	2.57	-11.57	8.99	-11.57	Percent	[+]
GDP Annual Growth Rate	2.35	3.96	8.60	2.35	Percent	[+]
GDP Constant Prices	16463341.91	16050601.38	18150356.45	56260.04	NGN Million	[+]
GDP per capita	1091.64	1055.84	1091.64	468.10	USD	[+]
Gross Fixed Capital Formation	2780352.23	2793779.10	2805531.46	17236.65	NGN Million	[+]
GDP per capita PPP	5606.56	5422.69	5606.56	2739.59	USD	[+]
GDP From Agriculture	3477845.24	3176598.13	4655322.16	2594759.86	NGN Million	[+]
GDP From Construction	740204.22	697366.62	740204.22	369190.91	NGN Million	[+]
GDP From Manufacturing	1829246.64	1637067.07	1829246.64	875408.17	NGN Million	[+]
GDP From Mining	1637476.71	1391091.74	3083257.13	1391091.74	NGN Million	[+]
GDP From Public Administration	420192.52	389597.47	614330.87	389597.47	NGN Millions	[+]
GDP From Services	6200866.06	5984386.62	6864557.92	4564086.31	NGN Millions	[+]
GDP From Transport	200076.31	166402.03	219878.67	144848.60	NGN Millions	[+]
GDP From Utilities	86681.88	78894.38	110386.78	51342.43	NGN Million	[+]

Source: IMF World Economic Outlook, October 2014

Table 2: Countries and their GDP between 1960-2014

Countries	GDP	Reference	Previous	Highest	Lowest	Unit	
Australia	1453.77	Dec/14	1560.37	1560.37	18.60	USD Billion	[+]
Brazil	2346.12	Dec/14	2392.09	2615.19	15.17	USD Billion	[+]
Canada	1786.66	Dec/14	1838.96	1838.96	40.77	USD Billion	[+]
China	10360.10	Dec/14	9490.60	10360.10	46.68	USD Billion	[+]
Euro Area	13402.70	Dec/14	13186.30	14104.50	245.70	USD Billion	[+]
France	2829.19	Dec/14	2810.25	2923.47	62.65	USD Billion	[+]
Germany	3852.56	Dec/14	3730.26	3852.56	215.02	USD Billion	[+]
India	2066.90	Dec/14	1861.80	2066.90	63.50	USD Billion	[+]
Indonesia	888.54	Dec/14	910.48	917.87	5.98	USD Billion	[+]
Italy	2144.34	Dec/14	2136.95	2391.88	40.39	USD Billion	[+]
Japan	4601.46	Dec/14	4919.56	5954.48	44.30	USD Billion	[+]
Mexico	1282.72	Dec/14	1262.25	1282.72	13.06	USD Billion	[+]
Netherlands	869.51	Dec/14	853.54	931.29	12.28	USD Billion	[+]
Russia	1860.60	Dec/14	2079.02	2079.02	195.91	USD Billion	[+]
South Korea	1410.38	Dec/14	1305.60	1410.38	2.36	USD Billion	[+]
Spain	1404.31	Dec/14	1393.04	1634.99	12.07	USD Billion	[+]
Switzerland	685.43	Dec/13	666.10	696.31	9.52	USD Billion	[+]
Turkey	799.54	Dec/14	823.24	823.24	8.02	USD Billion	[+]
United Kingdom	2941.89	Dec/14	2678.17	2963.10	72.33	USD Billion	[+]
United States	17419.00	Dec/14	16768.10	17419.00	543.30	USD Billion	[+]

Source: CIA World Factbook - This page was last updated on June 30, 2015

Nigeria GDP compared to some counties:

The nations that have the highest GDP in the world are the European Union (US$18.45Tr). United State of America (US$17.42Tr), China (US$ 10.38Tr), Japan (US$ 4.60Tr), Germany (US$ 3.86Tr), United Kingdom (US$ 2.95Tr) and

Nigeria which ranks 21st in the world has a GDP of 0.58Tr US$. Actually the true indicator of the well-being of a nation is determined by the living standard of its population.

The method used to decide each nation's living standard and general well-being is to compute its GDP per capita at current PPP (purchasing power parity) which will be mentioned below.

Nigeria GDP per Capita:

The Gross Domestic Product per capita is an important factor to be mentioned when considering the industrial achievement of any nation, especially in its comparison with other countries of the world by the use of the purchasing power parity (PPP) between countries. The GDP per capita at current PPP is one of the prime indicators used to assess the health of a country's economy. It represents the total dollar value of all goods and services produced over a specific period. A clear indicator of how well the economy of the nation is doing is when the GDP is viewed at current Purchase Power Parity (PPP). "A Purchasing Power Parity (PPP) between two countries, A and B, is the ratio of the number of units of country A's currency needed to purchase in country A the same quantity of a specific good or service as one unit of country B's currency will purchase in country B. PPPs can be expressed in the currency of either of the countries. In practice, they are usually computed among large numbers of countries and expressed in terms of a single currency, with the U.S. dollar (US$) most commonly used as the base or "numeraire" currency" - *Global Purchasing Power Parities and Real Expenditures. 2005 International Comparison Program. The World.*

Table 3, shows the GDP per capita at current PPP for Nigeria from 1990 to 2014 and projected to 2017. In 1990 it was $116.0 and

increased at a growth rate of 12.8%. The growth rate dropped to 1.8% in 1991, thereafter it increased relatively from 2.9% in 1992 to 10.8% in 2001 when it was $246.3. The GDP per capita at current PPP developed a rapid growth rate of 24.1% in the year 2002 with a value of $310.4 recorded. For the years 2003 and 2004 the growth rate dropped to an average of 13%. A drop to 7.9% was further experienced in 2005, but the GDP per capita at current PPP had increased to $463.9. An average growth rate of about 9.2% was recorded between 2006 and 2009 with GDP per capita at current PPP of $714.8 in 2009. In 2010 it was $800.2 at a growth rate of 10.2%. Thereafter it fluctuated between 4.9% in 2011 to 7% in 2014, but GDP per capita at current PPP increased from $856.6 (2011) to $1,057.8 in 2014. Projected growth rates of 7.3, 7.2 and 7.1% in the years 2015, 2016 and 2017 respectively, are expected to give a corresponding GDP per capita at current PPP of $1,155.8, $1,262.1, and $1,379.1 (Table3).

Table 3: GDP at current US$, int. $ and Real GDP growth

	Nigeria		
	GDP, current prices, billion $US	GDP, current PPP dollars, bln.	Real GDP Growth, %
1990	31.5	116.0	12.8
1991	29.0	122.0	1.8
1992	26.8	128.4	2.9
1993	17.0	137.4	4.6
1994	19.9	145.1	3.4
1995	41.6	151.2	2.1
1996	53.1	165.6	7.5
1997	41.8	177.3	5.3
1998	39.7	188.6	5.2
1999	44.5	197.0	2.9
2000	58.9	217.4	7.9
2001	57.4	246.3	10.8
2002	78.8	310.4	24.1
2003	92.4	357.8	13.0
2004	122.8	416.4	13.3
2005	160.7	463.9	7.9
2006	213.3	520.2	8.8
2007	253.4	585.1	9.6
2008	321.9	647.6	8.6
2009	268.9	714.8	9.6
2010	373.8	800.2	10.6
2011	418.8	856.6	4.9
2012	467.1	909.3	4.3
2013	521.8	972.6	5.4
2014	594.3	1,057.8	7.0
2015	657.2	1,155.8	7.3
2016	702.2	1,262.1	7.2
2017	749.1	1,379.1	7.1

Global Purchasing Power Parities and Real Expenditures. 2005 International Comparison Program. The World.

Industrial Overview:
About 60% of Nigeria's industries are based in Lagos and its surroundings. Also Kano, Ibadan and Kaduna are important centers of Nigerian industrial activities. The most important manufacturing industries in Nigeria are cement, beverages, food processing, cigarettes, textiles and detergents.

Revamping the Manufacturing Sector:
The manufacturing sector contributed 3.6% of GDP in 2008, which increased to 4.2% in 2009. The sector has not contributed much to GDP in the decade. Though industries like cement and beverages are attracting investment from home and abroad, about 850 other manufacturing companies have shut down between 2000 and 2010, or temporarily stopped production due majorly to electric power outages. Capacity utilization in manufacturing is about 53%. By allowing the importation of manufactured goods Nigeria reduced the sales of home produced goods since the 1980s. But government has been seen to be correcting this when in May 2010; it announced a USD1.3 billion fund to help banks extend credit to the manufacturing sector, following the decline in available financing after the global economic recession.

For the past two decades the Nigerian manufacturing sector has been plagued by inadequate infrastructure in general and lack of power supply in particular. With an estimated national electrical power demand of 25,000 MW, the country could only target generating 6000MW in 2009, which it failed to meet. To meet with the power needs the manufacturers have installed their own generators to compensate for spotty supply from the state – the manufacturing industry as a whole generated about 72% of its own energy needs. But operating these generators greatly increases the cost of manufacturing goods, and the cost increase is passed on to the consumer, making it difficult for Nigerian

goods to compete with cheaper imports. The government is embarking on a major drive to improve power generation with the express aim of improving conditions for industry: in March 2010 a decision was taken by the government to invest USD $3.3 billion in power projects throughout the country. The plan is slowly bearing fruit.

My Involvement in the Industry and Contribution to Knowledge:

I have as a young man, in the Secondary School been interested in becoming an engineer. My interest was further kindled when in the third form in a Literature Class; I studied a book called "Treasure Island" by William Shakespeare. From then on, the love of voyages on ships and being a marine engineer never left my mind. After School Certificate Examination, I got a Nigerian Ports Authority scholarship to study Marine Engineering at Medway College of Technology, Chatham, Kent, in the United Kingdom. Between 1965 and 1970, I qualified as a marine engineer after a diploma and 3 years sea experience on practical duties. Thereafter, my mind was however set on academics, so I left seafaring to enroll at University of London, Malet Street W1 in the Department of Mechanical Engineering, where I obtained B.Sc degree in Mechanical Engineering. In that institution I will not forget my Mechanics of Machine lecturer Dr. Drabble, who to me was very outstanding as a lecturer who made a most difficult course easy to understand and apply. Dr Drabble influenced my method of teaching students till date, just as I hope I also have affected my students.

I graduated from the University of London in 1973 and joined Brunel University, Uxbridge, Middlesex, United Kingdom where I studied Production Engineering between 1975 and 1980 to the doctorate level. I obtained Master of Production Technology Degree in December 1975 and the Doctor of Production

Technology Degree in December 1980. I take this opportunity to appreciate my supervisor at the Masters level, Dr. Greeves and at the Doctorate level, late Professor Paul Lowe. May his soul rest in perfect peace, Amen.

While in my course of study in Britain, I had been exposed to manufacturing operations in numerous industries. That knowledge was very useful when I returned to Nigeria to work in an engineering and management consultancy firm in 1980. I worked as a Senior Engineering Consultant with New Decade Consultants, Ahmadu Bello Way, Kaduna for four years. The firm planned and executed engineering and management projects for government and private sectors. In 1984 I was appointed the Head of Department of Mechanical Engineering at Federal Polytechnic, Bauchi. I lectured and also carried out engineering assignments for the Polytechnic. The courses I lectured were Mechanics of Machines, Applied Mechanics, Mechanics of Fluids, Jigs and Fixture Design, Heat Transfer and Exchangers, Machine Tools Process and Production Management. My team and I installed and commissioned four workshop training centers for the various departments, which were used to train the HND and OND students. We also installed a modern kitchen with full cooking machines and equipment for student instruction in catering and hotel management. Some of these machines were large and top grade. Like the gigantic oven, the electric and gas cookers, the dough mixers, the grinders and the electric sieves. I will always remember my friend and secondary school classmate Mr. William Omotowa, the acting Rector at that time, of the Federal Polytechnic Bauchi, whom God used to facilitated my appointment to the Polytechnic at period of my greatest need. The Lord will remember you for good always. I also remember my friend, Mallam Abdul-Wahab Gambo (Baba Mai Masara), he was the most gifted engineer I have met. I will not forget my very

able clerical assistant Mrs. Joan Orifa. My stay at the Polytechnic lasted two years.

In November 1986 I was appointed as Chief Engineer/Lecturer at Abubakar Tafawa Balewa University (ATBU) Bauchi. I lectured as well as maintained all university machines and equipment. My team and I installed the equipment for learning and demonstration in the thermodynamics laboratory. I taught Mechanics of Machines, Internal Combustion Engines, Heat Transfer and Exchangers, Applied Mechanics and Mechanics of Fluids. I will not forget my brother and pastor, Reverend Professor Sam Ale of the Department of Mathematics, who was also the shepherd of the campus church, the "Chapel of Light." I worked at ATBU for three years, after which I relocated to the southern part of this country.

I was appointed the Operations Manager of Kwara State Land Development Board (KSLDB). My duties were to manage and service heavy duty machines and equipment, which we rented out to construction workers and farmers. The machines were, bulldozers, earth-digging and moving pale-loaders, earth surface graders, farm tractors, ploughs, harrows, ridgers, various capacities of grain shelling machines, combine harvesters, 5 ton per hour grain drier and a standard maintenance workshop. Our largest customers were from the farming communities who rented the machines for the clearing and preparation of virgin land for cropping. The staff strength under me was seventy, which consisted of management, skilled staff and operators. I will not forget Mr. Dare Olisa, a very highly efficient administrator and a friend. Nor can I fail to mention the dynamic, one-of-a-kind tractor-operator, "Asaba", with whom nothing was impossible.

Following a proposal jointly written by us at Kwara State Land

Development Board and the State Ministry of Agriculture, a new company was commissioned by the Federal Government of Nigeria on our mode of operations. It was called the National Agricultural Land Development Authority (NALDA). I was the first Director of NALDA for Kogi State in 1992. There were some differences in the mode of operation from the initial concept of KSLDB in that it was only to service farmers grouped in communities. After clearing the farm land, ploughing, harrowing and ridging, it is divided into plots each of 4 hectares and given to interested farmers. All necessary inputs like seeds, seedlings, fertilizer and extension officer guidance were made available. After harvest the farmers were made to pay back part of the production cost and continued paying until their debts were settled. Our first farm site was at Ofere in Kabba Bunu LGA of Kogi State. NALDA thrived for 4 years until it was scrapped. The reason being inadequate funding from the Federal Government and bad management at the executive center of NALDA. Some two people left impression in my life which I will always remember, they are Mr. M. M. Akinola of the Kogi A.D.P at that time and Mr. J. Olorunmola.

I did engineering consultancy work form between July 1995 and November 1998 with Michey Fid Enginners, Adewole Housing Estate, Ilorin and worked mostly for the private sector. At Adewole Housing Estate the following families touched my life, the Okeowos, the Olupidis, the Gidados, the Ajes, the Adeshinas, the Olobayos, Mr. Tunde Akinremi popularly known as Uncle T, the Latinwos, and the Odelowos.

My Involvement in the University System and Contribution to Knowledge:

In November 1998, I joined the teaching staff of University of Ilorin as a Senior Research Fellow in the Department of Mechanical Engineering. I taught 300 Level, 400 Level and 500

Level students the following courses, Mechanics of Machines, Mechanical Vibrations, Mechanics of Fluids, Applied Mechanics, Thermodynamics and Heat Transfer. I also carried out the assignments listed below:

* Chairman, Certificate Screening Committee for final year students, Faculty of Basic Medicine. 2009
* Chairman, Faculty of Engineering and Technology Community Based Experience and Services. 2008
* Chairman Faculty of Engineering and Technology Examination Misconduct Committee. 2008
* Acting Head of Department of Mechanical Engineering University of Ilorin. 2004 & 2009
* Member Faculty of Engineering Project Committee, University of Ilorin. 2004
* Faculty of Engineering Representative for Faculty of Business and Social Studies, University of Ilorin. 2004
* Final Year Level Adviser, Department of Mechanical Engineering. 2002
* National Returning Officer for the Independent National Electoral Commission (INEC) during the 1999 National Election (Federal Government of Nigeria). 1999
* Chief Examination Invigilator, Faculty of Engineering Technology, University of Ilorin. 1999

Research Interest:

My research interests are:

(1) Design and Fabrication of Medium and Small Scale Machines and Appliances.
(2) The Study of Vibration Effect on Machine and Factory Floors.
(3) Production Engineering.
(4) Hydro-turbine Technology.

In the Field of (1) Design and Fabrication of Medium and Small

Scale Machines and Appliances, I have designed, constructed and tested 15 machines and appliances. In the first of these, **Olusegun**, (2002) I designed a master servo control valve for a truck with multi-directional tipping device. Unlike the regular tipping action of a truck, which discharges loaded material in one direction, usually backwards away from the driver, the multi-directional device was designed to tip load in 3-directions. It could tip backwards away from the driver, or to the right-hand side, or to the left-hand side of the driver. The device used a supply pressure of 116.8MN/m^2 to activate the tipping in any of the three directions. **Olusegun** (2006) designed and fabricated a solar box cooker using locally sourced materials. This appliance was cheap in cost and could meet the cooking needs in the rural and urban areas. The only material in the solar box composition that may be difficult to get locally was the titanium oxide. But many of these solar box cookers could be fabricated and made affordable to the people. Money could also be made available for research to upgrade the efficiency of the appliance.

My research in production engineering under (3) above is linked to (1). As a matter of fact, the design and fabrication of medium and small scale machines and appliances, is production engineering. It became necessary therefore, to find a method of costing medium and small scale industries for the benefit of interested entrepreneurs who will desire to go into the production of the designs carried out by researchers in this field. As a result, Adekunle and **Olusegun** (2007) used cost modeling technique to set up a small and medium scale groundnut oil industry. Interactive software that helped to generate and analyze the cost of setting up a groundnut oil processing industry was used to investigate the cost models for small and medium scale groundnut industries. The software helped to provide business advisory service techniques that ensured that the enterprise was profitable. Also **Olusegun** *et al* (2009) used the

direct multivariate approximation technique to numerically formulate mathematical models for composite tiles production. Various proportion of granite and laterite mix was used to produce experimental tiles with specifications of maximum particle size of sieved materials. The characteristic models of composite tiles developed in this study were very reliable to predict future estimates of material mix in tile production. The research team I worked with were encouraged by the information obtained in the two modeling techniques above which spurred us ahead, in our effort to design and fabricate a number of machines, some of which will be mentioned.

Adekunle, Ohijeagbon and **Olusegun** (2009) developed a melon shelling machine that was manual and motor operated, which removed the shells by impact technique. The machine shelled two of the main cultivars found in Nigeria using a 2hp motor and removed 80% of the coating with an efficiency of 68%. **Olusegun** and Ajiboye (2009) designed and fabricated a vertical squeeze cassava pulp dewatering machine which had a capacity of 356kg per hour. It operated with a 7.5hp motor and reduced a moisture pulp level of 80% to 29.85% in 33.72 minutes. The cassava pulp dewatering machine was 7 times quicker than the multipurpose press designed by IITA at that time and 40 times faster than the local method of dewatering. **Olusegun** and Ajiboye (2008) saw the need for the consumption of more oranges for health reasons and also that its berry, seeds, leaves and skin be used in the cosmetic and pharmaceutical industries. We used a 1hp electric motor to generate a peeling force of 114.7N which peeled one orange at a time as a prelude to a machine in the future that will peel many oranges. **Olusegun** and Ajiboye (2009) also developed a sandcrete block compactor machine that operated at an angular speed of 151.8rad/s and provided vibration through a drive shaft eccentric system. Various sizes of sandcrete blocks were compacted after being vibrated in the appropriate

mould and refilled for lost space. The compacting strength was 0.99N/mm^2. When compared with the conventional universal block making machine, it occupies 1/3rd the space taken and cost ¼ (one quarter) the price of the universal block making machine. The cost of the sandcrete vibrator compactor when it was made in 2009 was N35,000. It could make 500 blocks in a day of 8 hours.

My team and I also design and fabricated machines for the aquaculture industry when, **Olusegun** and Adekunle (2009) designed and fabricated a worm-like pellet fish meal processing machine which had a capacity of 162kg/hr. Three types of worm-like feeds, 2, 4, and 6mm diameter at 25mm length were produced using an extrusion pressure of 416.2KN/m^2. The size of the machine was 580 by 500 by460mm. Also a 113.1Kg/hr fish meal pellet processing machine which produced 4mm diameter pellets, with an average length of 6mm was designed and fabricated by **Olusegun** et al (2015). Operating with a 5hp and a motor speed of 2000rpm, the fish meal pelletizing machine utilized 4Kg of ingredients to produce 3.77Kg pellets at an efficiency of 94.2%. This machine will be useful to medium and small scale aquaculture farmers and also diminish the need for foreign sources of fish meal in the aquaculture industry, thus conserving foreign exchange.

One area of my research interest is the study of the vibration effects on machines, equipment and factory floors, **Olusegun** and Ajiboye (2008), investigated the energy released on some lubricant using the shock response spectra technique. In this work, asperities were known to have been filled with ferrous ions when the moving piston rubbed the cylinder walls of the shock response spectra. The heat generated in the ferrous ions that filled the asperities formed an undiluted complex chemical liquid which released energy that served as sacrificial material

when wear occurred, a process known as "energy release" (ER). This technique was used to assess the suitability of the following lubricants, Marfark3, Dot3, and SAE40. The lubricant SAE40 had a high ER build-up but very low dissipation rate, which makes it ideal for high speed engines. Marfark3 had a low ER build-up a rapid dissipation rate, which makes it suitable for low speed engines. Markfark3 is ideal for greasing in slow running engines. Dot3 had qualities which were suitable for usage as brake fluid. In another research by **Olusegun** *et al* (2013) we carried out a study on the characteristics of energy released when melting aluminum and brass. The rationale for this study is to salvage some scrap materials for useful research investigations and other possible uses. The work calculated the energy released (ER) when melting locally sourced brass and aluminum samples, for the purpose of finding their compatibility when aluminum was joined with brass as the filler. Crucible furnace was used to melt the metal samples. The results obtained showed that the energy transferred to brass was 35,915kJ and to the aluminum 18,306kJ. The solidus point for the local aluminum occurred at 717°C with an ER of 491KJ, while that of brass was 1100°C with an ER of 9756KJ. The liquidus point of the local aluminum was at a temperature of 750°C with an ER of 515KJ, while brass was 1135°C and 10,075KJ. Temperature soaking time of 5 minutes during transition and an ER of 24KJ for transformation from solidus to liquidus aided annealing of the joined aluminum such that distortion from thermally induced stress did not occur. It was recommended that joining of the local aluminum would best be achieved at a solidus temperature range of 717°C to 740°C, and the brazing torch should finish its traverse within 30 seconds.

Furthermore on vibration, its disturbance on equipment when allowed to continue unchecked will damage the machine and its base or foundation support. **Olusegun** and Adeniyi (2010) on our work, "Foundation and Vibration Isolation for Large and

Small Machines", confirmed that the mode or severity of the damage by vibration depended on the frequency, amplitude of the vibration and the natural frequency of the equipment. Many methods of damping were investigated and suggestions were given for best isolators to use for various machines and how to achieve the best design for the factory floor. Also Ohijeagbon, **Olusegun**, Adekunle, Oladosu, and Bodunde investigated the vibration on a factory where thirteen roller machines, in operation at a flour mill, all on one floor, were analyzed for spectra transmission and propagation, using a vibration analyzer. The vibration analyzer was placed at 8 different positions around each roller machine, generating unique spectra curves symbolic of signals transmitted. Results indicated that out of the 7 machines requiring isolation, cork would be needed for 3 with maximum displacement of 0.19 to 0.20mm, while composite pad would be needed for 4 with a maximum displacement of 0.10 to 0.16mm. The study had shown that vibration effects could be successfully controlled on factory floors through the vibration analyzer application, thus, minimizing hazardous effects on factory workers and facilities.

In our publications in 2009, 2010 and 2012 on technical enhancement to development, we continued in the search for quality components in manufacturing not only to save cost but also to produce durable parts. Alabi, **Olusegun** and Ajiboye in 2009, 2010 and 2012, published 3 research findings on component parts preparation for application in production processes. The first of these 3 findings was published in 2009, when the stress, strain and strain-rate in heat treated medium carbon steel samples were measured in relation to the constituted material properties. It was discovered that the mechanical failure of component parts as well as in build up structures could be prevented if proper quality control was carried out at point of component's manufacture. Engineers

were known to analyze samples from which accurate predictions were made about the properties of the materials that were produced for the purpose of component and structural processing. This work had produced and tested heat treated 1030 steel by pulling them in tensiometer to fracture. The analysis of data was done using none regression analysis, SPSS soft ware, to obtain the material related properties for each of the specimen. The yield strength and ultimate tensile strength of the specimens were significantly different. The highest and lowest yield strength was annealed specimen 450 MPa and normalized specimen 220 MPa respectively. The highest and lowest ultimate tensile strength was hardened specimen 608 MPa and normalized specimen 320 MPa respectively. With a strain-rate sensitivity C of 0.0562, normalized specimen was less ductile than hardened specimen which had a C value of 0.0083. By the analysis, normalized and tempered specimen that had the strain hardening parameter n of 0.1270 and 0.1240 respectively were less ductile than hardened and annealed specimens with n values of 0.0439 and 0.0571 respectively.

In our second publication in 2010 on technical enhancement to development, we investigated the cutting forces in heat treated medium carbon steel when turning on a lathe machine. The study used experimental methods based on orthogonal cutting process to measure the cutting forces using a dynamometer while machining the test specimen with a diamond cutting tool at 5° rake angle. For annealed and hardened test specimen, the cutting speed of 245 rpm was ideal for machining when it gave a fine surface finish. Also for precision machining, dry turning was by far a better way to save cost and produced cleaner components than wet turning. This was because wet machining was relatively more expensive, and hazardous to health. Normalized and annealed specimen required lower cutting forces and chip formation was slow. Tempering and annealing medium carbon

steel facilitated rapid machining and chip formation was rapid. It was therefore an advantage to temper or anneal medium carbon steel before processing into component parts in the manufacturing industry as it saved cost and gave fine component surface finish.

The third publication in 2012, was on the cutting temperatures distribution in machining heat treated medium carbon steel on a lathe. This study was carried out on medium carbon steel subjected to various form of heat treatment operations by assessing the temperature distribution during the machining process. The model of oblique band heat source, moving in the direction of cutting in an infinite medium with an appropriate image heat source was used in this investigation. The model analysis was carried out separately on the chip, so that the tool and the work material to numerically determine the temperature distribution during machining process using finite element method with nodal grids was determined. Johnson-Cook model was used to determine the work materials flow stress upon which the material properties were determined. Stress/strain tests were conducted on the specimens to determine the materials' constant parameters which were used as the input parameters to the modeling equation written in Visual Basic 6.0. The optimum shear angle of 20° was used for the machining process and the frictional characteristics were also determined. The temperature along the shear plane AB was determined with reference to coordinate axis within the tool, work-piece and the chip using the model. The results which compared favorably with other results from literatures, provide basis for the design of machining variables for optimum and quality machined products which can also be applied in the computer programming of NC machine for precision machining.

My Contribution to the University Community

My Vice-Chancellor Sir, the university has given me the privilege

to serve in the following capacities. I was Chairman School of Engineering and Technology Staff Development Award Committee at Federal University of Technology, Minna, in 2011 and 2012; and from 2012 to 2014, I was Chairman of Production Engineering Option in the Department of Mechanical Engineering at FUT, Minna. I was Acting Head of the Department at the University of Ilorin from August 2009 to September 2010, also from January 2006 to December 2006. I was National Returning Officer for INEC in Kwara State during the 1999 National Election. I was the Chairman, Faculty of Basic Medicine and Sciences School Screening Committee, University of Ilorin in 2009. In the year 2008 to 2009, I was Ag. Chairman, Faculty of Engineering and Technology, Allegation of Examinations Misconduct, University of Ilorin Also in 2008 to 2009, I was the Ag. Chairman, Faculty of Engineering and Technology, Community Based Experience and Services, University of Ilorin. I was the Chief Examination Invigilator, Faculty of Engineering and Technology, University of Ilorin 1999 to 2009. In the year 2002 to 2008, I was the Acting Chairman, Faculty of Engineering and Technology, Certificate Screening Committee, University of Ilorin. Also at the University of Ilorin I was member of the following committees, Faculty of Engineering and Technology, Allegation of Examination Misconduct, 2004 to 2009; Certificate Screening Committee, 1998 to 2008 and Exhibition Project Committee, 2004 to 2009.

My Conclusion

My Vice-Chancellor Sir, many researchers and I in the academic sector (universities and polytechnics) have designed and fabricated numerous prototypes which have not served the purposes for which they were intended and invented. Today, the researchers' inventions are mostly used for inter-university exhibitions. The rest are dumped carelessly in the academic

campuses and are allowed to rust and litter the premises. These prototypes were meant to be developed into production machines and appliances for general usage, but some factors have hindered this development. The major factors are finance, epileptic power supply, and lack of foresight. The funding for intensive research is not available, and the electric power supply is not sufficient for any meaningful production strategy implementation. Money should be sourced from the Universities, in collaboration with foreign Universities, also from the State and Federal Governments. The Universities should change from operating in Schools and Faculties to the Collegiate System with full autonomy. That way, the Departments will be spurred to be productive and profitable. Then every prototype invented will be improved upon and made viable. The machines will be sold to entrepreneurs and also be used by the Universities to produce commercially profitable commodities. This way we will create employment and enhance national development. By the 2012 Enterprise Baseline Survey there are 17 million SME in Nigeria, employing 32.41 million persons and makes a contribution of about 46.54% to the nation's GDP in nominal terms. Interest in the SME machines that have been invented and are currently being researched at the academic institutions will raise the contribution of SME to well above 50% of the nation's GDP.

The Way Forward:

Nigeria clearly has a potential for growth, but has faced a number of challenges in the past years. One of its biggest current set back is the fall in crude oil price, which implies that the government will likely have problems funding development and must generate new sources of income. Hopefully, this situation will lead to much-needed reforms and a crackdown on corruption to release such funds. It was a known fact that last year, the head of

the central bank asked why US$20 billion was missing from the oil fund accounts. There are trillions of US$ stolen from Nigerian funds that were meant for the development of this nation. It is our prayers that the present national government of change will recover these stolen funds from wherever they are stashed away. Those stolen funds will certainly set us in very good standing for development. While lower prices will likely have an adverse impact on Nigeria's fiscal situation and foreign reserves, government debt is only 13% of gross domestic product (GDP).[1] Planned spending cuts and efforts to improve tax collection in the 2015 budget should mean that the government may not face major funding issues this year. Though the oil and gas sector actually provides less than 15% of Nigeria's total GDP, nevertheless, the oil price decline has prompted the government to reduce its 2015 GDP growth forecast to 5.5%, down from an estimated 6.23% in 2014. With the current privatization and government reform efforts, along with the land size and population of Nigeria, it is still believed there is a good chance of a strong growth going forward, even if oil prices don't rebound significantly from today's levels.

When government is able to raise adequate funds as suggested, the Universities will be encouraged to form Collegiate instead of Schools and Faculties. Then researchers will be adequately supported with enough funds to work in teams. Each team will have a project leader bearing the financial entitlement of members of his team according to output from every research assignment. Then the many discarded prototypes in the institutions will be revisited, and prototypes will become machines in active service. These machines and appliances will be produced in commercial quantities from the University Collegiate of Engineering. This will most certainly enhance development, if the many unemployed graduates and non-

graduates are empowered by the government to purchase these machines and put them into active production usage for commercial benefits.

There are significant constraining problems ahead, but it is believed that the positives outweigh the negatives and now may be a good time to invest in Nigeria. It will be profitable to be particularly interested in opportunities outside the energy sector, like consumer products as well in financial services.

The long-term economic strength of Nigeria looks good for several reasons:

* Nigeria is one of the fastest-growing economies in the world, with GDP growth rates above 6% every year since 2003.[4]
* It is home to more than 170 million people, Nigeria is the largest country in Africa by population and among the top 10 most populous countries globally. Additionally, the population is relatively young, with a median age of just over 18.[5]
* It is important to note that Nigeria exports more than 100 different non-oil commodities as well as a wide variety of finished or semi-finished manufactured products to countries around the world, while oil remains the dominant export; there are many potential opportunities beyond the energy sector.

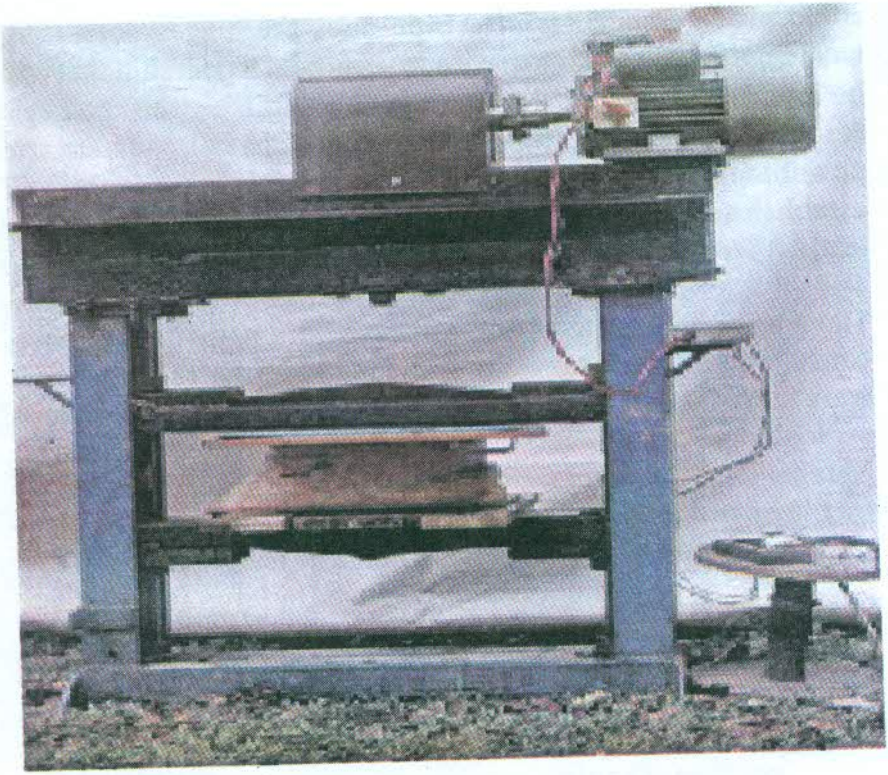
The efforts toward privatization and investment in areas such as mining, agriculture, finance and manufacturing to diversify the country's dependence on the oil sector could bear fruit in the longer term. Also there is the Nigerian movie industry, "Nollywood" which generates nearly $600 million a year and employs more than a million people.[7] While a lower oil-price

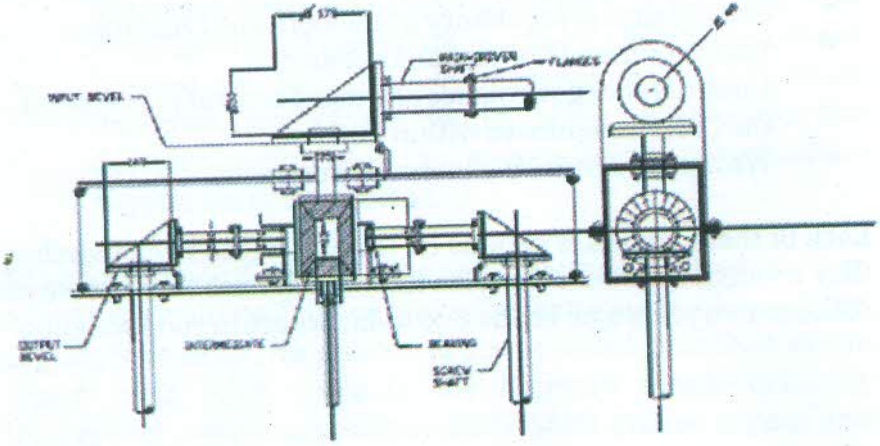
could prove a short-term test, perhaps the biggest long-term challenge for Nigeria is to have a government leadership that will be intent on economic development and utilizing the country's resources to develop infrastructure like roads, railroads, electric power, water, sewerage systems, and so on. It is believed this will establish a platform for the growth of new enterprises and likely lead to more employment.

The Nigerian banking sector witnessed dramatic growth post-consolidation. However, neither the industry nor the regulators were sufficiently prepared to sustain and monitor the sector's explosive growth. However, this sentiment proved misplaced for 8 main interdependent factors led to the creation of an extremely fragile financial system that was tipped into the turning point by the global financial crisis and recession. The factors were:

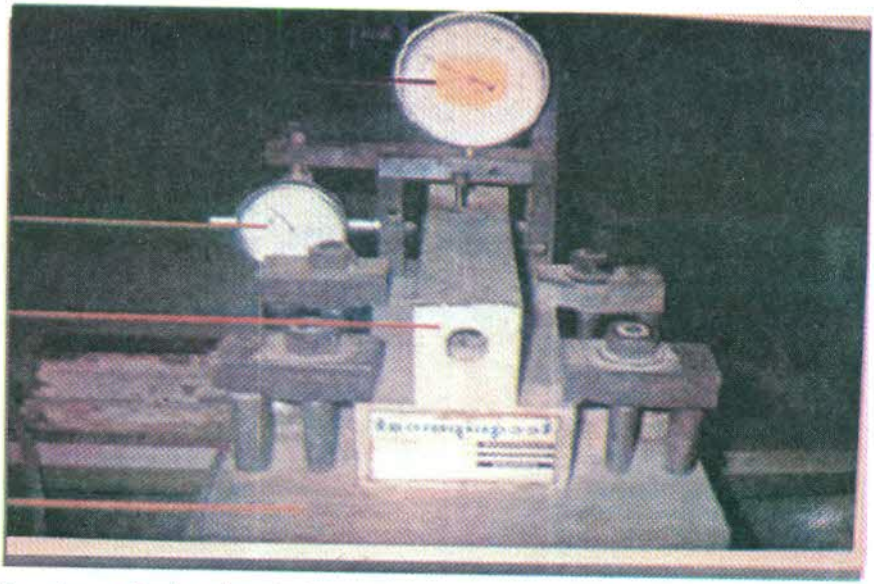
* Macro-economic instability caused by large and sudden capital inflows
* Major failures in corporate governance at banks
* Lack of investor and consumer sophistication
* Inadequate disclosure and transparency about financial position of banks
* Critical gaps in regulatory framework and regulations
* Uneven supervision and enforcement
* Unstructured governance and management processes at the CBN/weaknesses within CBN
* Weaknesses in the business environment.

Each of these factors is serious on its own right. Acted together they brought the entire Nigerian financial system to the brink of collapse two years ago. Thank God today we are in good standing.

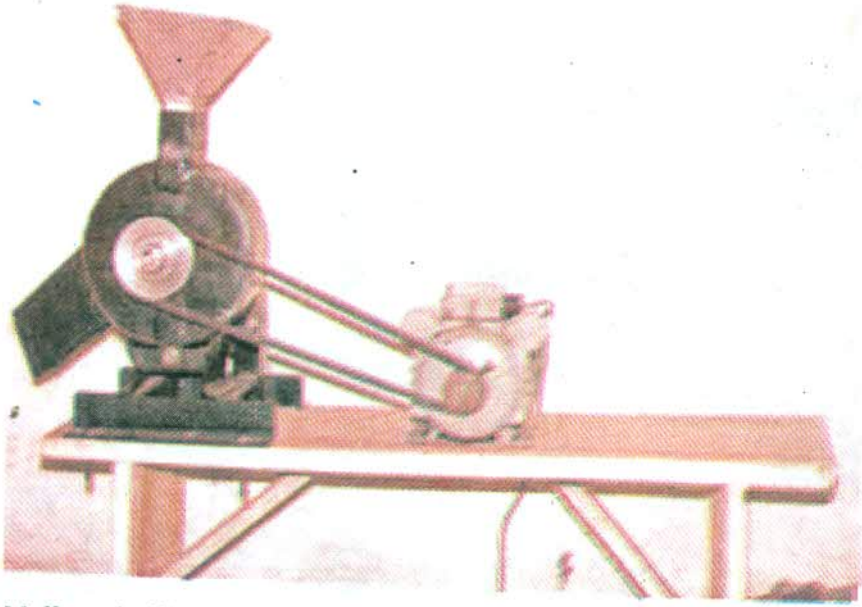




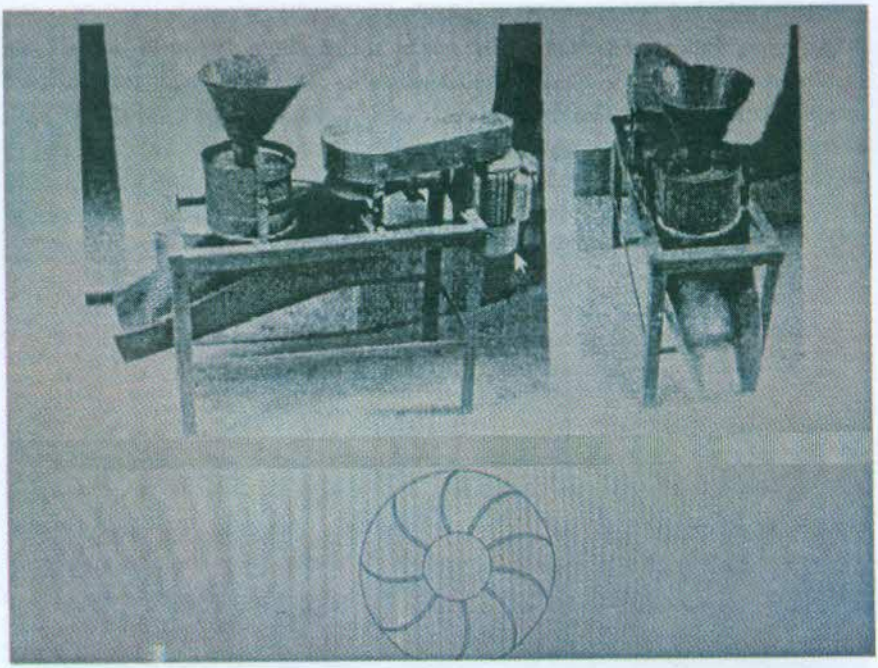
Cassava pulp dewatering machine



Specimen lathe chuck dynamometer and tool holder

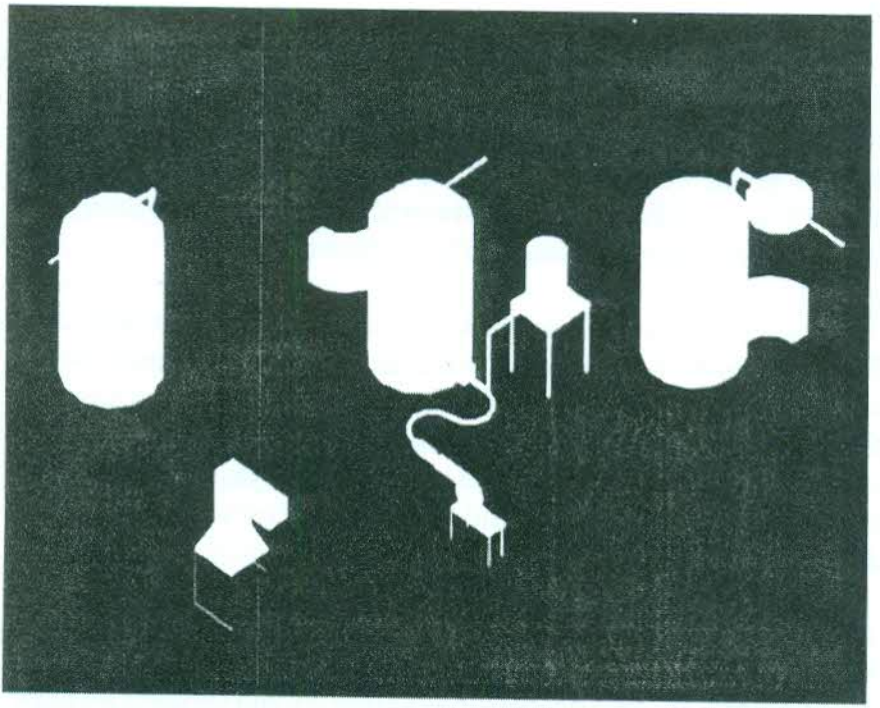


Mellon shelling machine using impact method



Front and side view of the melon seed shelling machine

Chip morphology and behavior when turning AISI 301



Bale-out Crucible Furnace designed and fabricated

Acknowledgement:

Blessed be the Lord of Host, the King of Kings and the Messiah Jesus who has always been and will continue to be my everything. By His grace have I achieved the peak of my career. My Vice-Chancellor Sir kindly allow me to recognize the people who have played significant roles in my journey to this very day.

1. My parents, Lawyer Julius Ayodele Olusegun (deceased) and Mama Comfort Yetunde Olusegun (deceased) who were responsible for taking care of me. But my mother, Mama Comfort Olusegun single handedly paid for all the cost of not only my education, but that of my four siblings also who were all older than I. May her gentle soul and that of Papa rest in perfect peace, Amen.

2. My Vice-Chancellor Sir and my friend, you are worthy of a special mention in this occasion, because of the role you played in my appointment as a professor at a time when I thought all hope was lost. Thank you very much and may God continue to use you to foster justice and fairness everywhere you go. Amen. Also I sincerely appreciate the role played in my life by Prof. S. O. Adeyemi, the former VC of F.U.T., Minna. Thank you sir. I acknowledge the former VC of this institution, Prof. M. S. Audu, for offering me appointment as a Professor to be in this University.

3. My siblings, Aina Joseph (deceased), Adebayo Joseph (deceased), Dr. Titus Oladipo Joseph-Adebayo and his wife Bosede, Mrs. Hilda Modupe Spencer, Fumilayo Olusegun, Dele Olusegun, Patricia Olusegun, Ayodeji Olusegun, Patient Olusegun, Aboyade Olusegun, Bola Olusegun, Bukky Olusegun, Dipo Olusegun and Mrs. Yemisi Ekundayo Taidi and their spouses. Thank you for your tolerance.

4. I appreciate my teachers in the primary school, especially Mrs. Modupe Ifere (deceased), who taught me in primary 6 and 7 at St. Bartholomew's School, Wusasa, Zaria. She made me to like Arithmetic and the fundamentals of the Sciences which made me the Engineer I am today. May her soul rest in perfect peace. I pray that her children will reap the reward of her selfless labour and dedication to excellence, Amen. I also thank my teachers at the Secondary School, St. Paul's College, Wusasa, Zaria (now Kufena Secondary School). I especially remember the principal Mr. Peter John Johnson, Mr. Hathaway, Mr. Adamu, and Mr. Okoli. Also I sincerely appreciate my Lecturers in the University of London and Brunel University, Middlesex, U.K, especially Mr. Hogbin, Dr. Drabble, Dr. Greeves and Prof. Paul Lowe (deceased).

5. I thank the present Dean of the School of Engineering and Technology. Prof. S. Sadiku, and all the past Deans of S.E.E.T., especially Prof. M. S. Abolarin. I also thank all my colleagues in the School of Engineering and Technology.

6. I appreciate the Dean of the Faculty of Engineering and Technology at University of Ilorin, Prof. Y. A. Jimoh, and all my former colleagues in the Faculty of Engineering and Technology at University of Ilorin.

7. I recognize all my present and past PhD, M.Eng and Undergraduate Project students. I appreciate all my present and past students at Federal University of Technology, Minna, University of Ilorin and all the other institutions I have served.

8. I recognize the entire Olusegun clan from Odo Akete compound in Kabba Town, and Ajugba compound of Olle-Bunu of Kabba-Bunu LGA, Jonkosi compound at Oja Gboro, Ilorin; Joseph Adeboyes clan from Maro compound at Odo-Ape, Kogi State. I appreciate Mama Abigail George (deceased) of the Royal family

of Dukube in Okirika Land from the Uzoaru compound George-Ama, and Alhaji Zailani Madaki (deceased) of the Royal House of the Sultan of Sokoto, the Sarkin Gobir Mohammadu Adiya (deceased), the Malami and Ramallan families.

9. I recognize Dr. and Dr. (Mrs.) Tunde Akinremi, Prof. and Dr. (Mrs.) Yomi Omotesho, Prof. and Dr. (Mrs.) Gbenga Mokuolu, Chief and Chief (Mrs.) I. Oyawoye, Mr. and Dr. (Mrs.) L. Ahmed, Rev. S. O. Akindele and family, Prof. O. O. Balogun and family, Madam Rosemond Dallatu and family, Mr. Steve and Mrs. Julie McRorie, the Olaniyi family, Engr. and Mrs. M. A. Olorungbon and family.

10. I appreciate the pastoral team of the UMCA.

9. I am grateful to my very close friends from Secondary School, St. Paul's College, Wusasa, Zaria, Dr. Amos Adebanjo Olagboye (Lemmy Causion) and Prof. Johnson Olatunji Dare (Johnco). I also remember Dayo Aina (deceased) and Engr. Niyi Oguntoye (deceased)

10. I thank God for the supportive role played by my children and grandchildren. They are Michelle, David, John, Yvonne, Tyronne, Adele, and Philip.

11. Finally, I very highly appreciate my wife. She is my prayer-partner, my counselor whose advice has always been accurate, the organizer, and a double Princess both in her father's and mother's houses, I present my wife Princess Amina Faye Olusegun.

My Vice-Chancellor Sir, distinguished Ladies and Gentlemen thank you for your patience. God bless you all.

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Source: International Monetary Fund, "IMF Executive Board Concludes 2014 Article IV Consultation with Nigeria," March 2015 press release. (Figure based on 2013 data.)

Source: World Bank, 2012 Data; International Monetary Fund, 2014 data.

Source: National Bureau of Statistics, Nigeria, January 2015. There is no assurance that any estimate or forecast will be realized.

Source: The World Bank, GDP Growth (annual %), World Development Indicators.

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Source: United Nations Africa Renewal, "Nigeria's Film Industry: a Potential Gold Mine?" May 2013.

Source: SME's contribute half of Nigeria's GDP; Vanguard News 14th Dec., 2012.

Text of the Convocation Lecture by Mr. Sanusi Lamido Sanusi, Governor of the Central Bank of Nigeria, to mark the Annual Convocation Ceremony of Bayero University, Kano, 26 February 2010.

My Brief Profile:

My studentship started at St. George's Primary School, Zaria, Kaduna State. I transferred to St. Bartholomew's Primary School. Wusasa, Zaria. My Secondary School education was at St. Paul's College, Wusasa, Zaria. I had Higher School Certificate (HSC) and Advanced Level GCE contact sessions at Titcombe College, Egbe, Koge State, Emergency Science School, Victoria Island, Lagos State and at Medway College of Technology, Chatham, Kent, U.K. I was in the United Kingdom on and off between 1965 and 1980. I obtained my first degree B.Sc in Mechanical Engineering at the University of London, the second degree M. Tech in Production Technology and the third degree, PhD in Production Technology at Brunel University, Uxbridge, Middlesex, U.K. While in the United Kingdom I was exposed to a number of industries that have helped to shape my understanding of engineering especially in my field of production engineering. On my return to Nigeria in 1980, I was Senior Engineering Consultant with New Decade Consultants, Ahmadu Bello Way, Kaduna. In 1984, I was appointed the Head of Department of Mechanical Engineering at the Federal Polytechnic, Bauchi. In 1986, I was employed as the Chief Engineer/Lecturer at the Abubakar Tafawa Balewa University, Bauchi. I became the Operations Manager at the Land Development Board at Ilorin, Kwara State in 1989 and in 1992, I was appointed by the Federal Government as Director of Kogi State National Agricultural Land Development Authority. I had a brief spell in consultancy before joining the academics again in 1998. I was appointed a Senior Research Fellow in the Department of Mechanical Engineering at University of Ilorin in 1998, where I lectured and performed other duties for twelve (12) years. Thereafter, I was appointed as a Professor in the Department of Mechanical Engineering at this great institution, the Federal University of Technology, Minna. I transferred service and became a full staff of this University on 1st October 2010.