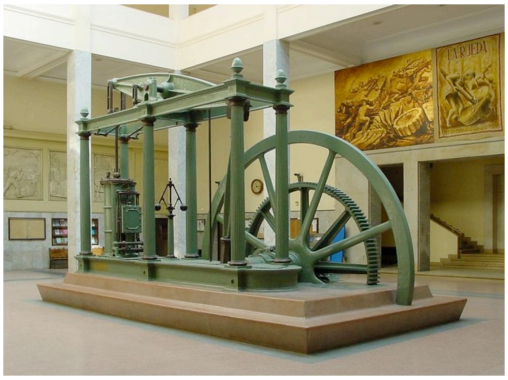
SCIENCE AND TECHNOLOGY AS AN ENGINE FOR ECONOMIC DEVELOPMENT IN AKWA IBOM STATE

A casual perusal of the countries of this world immediately reveals that the countries with strong economies are also the ones with a strong science and technology base. These are the countries that usually produce Nobel laureates and that invent things that the rest of the world wants to buy. One of these technologically strong countries, Japan, has very limited natural resources. From the Japanese example we can deduce that an absence of natural resources is not a hindrance to a strong, vibrant and buoyant economy if the country adopts, embraces and applies science and technology. We can also take a small leap forward and postulate that a society blessed with natural resources like Akwa Ibom and Nigeria would have a strong and prosperous economy if it embraced science and technology as second nature.

Let us also take a quick look at Nigeria in general and Akwa Ibom in particular. The economies of both entities can be described as a one - horse sleigh. The worst part is that despite being totally dependent on revenues from the one resource, crude oil, the country is yet to acquire the technology to prospect for, develop, mine, refine and market this resource by itself. Akwa Ibom in particular is a Civil Service state. This means that the government is the largest employer in the state and there are no internally generated revenues to boast of. As we all know oil wells do run dry and ours will some day. What will become of us then? Will posterity bless or curse this generation who had a windfall of revenue and did or did not use it to lay a solid foundation for a future of non crude oil based economy?

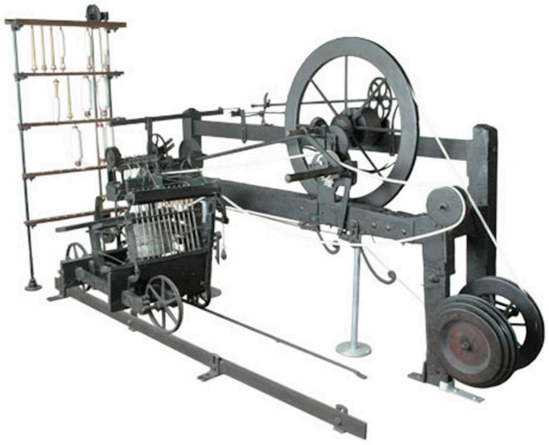
Cognizance of the situation on the ground today, if the prevailing conditions continued in the future, one would expect a curse rather than a blessing from future generations. Can we change this to a blessing? Borrowing a phrase from American president Barack H. Obama's successful campaign, "Yes we can".

Let us quickly review how today's strong economies came to be that way. Practically all countries started out as agrarian economies and by embracing scientific research and technology moved to multi-faceted vibrant economies. They started small and simple. Look at James Watt's steam engine (see picture 1) or the spinning wheel (see pictures 2 and 3). They look very simple compared to today's machines for accomplishing the same tasks.



Picture 1 James Watt Steam Engine [1]

Picture 2 Model of the Spinning Jenney [2]



Picture 3 The Spinning Mule [3]

How about steel making equipment? Compare the early Bessemer converter and blast furnace to today's technology (see Pictures 4a, 4b and 5). The point here is that

these countries started to apply technology in very simple ways and improved upon that simplicity as they learned more about Nature's laws. We can do the same. In fact we can do it faster than they did because we now have the benefit of their experiences at our fingertips. What we lack as we see it is the patience to learn to apply the science and technology and the will to try. You might even say we lack the belief in ourselves that we can do as they did. This unjustified self - doubt persists even in the face of the evidence that when our children are removed from our society and put in these other countries, they perform just like all the other children in that new environment. How do we change this situation and effect a paradigm shift in our worldview?

Picture 4a Early Bessemer Converter [4a]

Picture 4b Early Bessemer Converter [4b]

Picture 5 Oxygen Converter [5]

Consider this. At the beginning of the last century, man did not know how to fly. In a scant 65 years not only did man learn to fly but he also landed on the Moon and launched man made machines that visited other celestial bodies. The human genome has been successfully sequenced and genetic engineering is producing results unimaginable even thirty years ago - from growing artificial human organs to modified crops that are drought, disease and insect resistant. Communications has advanced to where we can talk wirelessly to anyone anywhere in the world. Computer technology has revolutionized from manufacturing to security in the home, through social media it has linked heretofore-unthinkable numbers of people together around the world. The speed of transportation and capacity to move thousands of tones of good has greatly risen. In short knowledge is increasing at an exponential rate.

We cite all these to highlight the fact that we can no longer afford to lose a day, a month, a year, an administration and a generation if we are to be relevant in the global economy. We must have a paradigm shift in our worldview. We must get rid of mentality of a civil service state, embrace science and technology to become a manufacturing state, utilizing and exploiting our natural resources to the fullest extent.

Based on current practice we outsource our manufacturing to other nations. Even when, say they construct roads for us, there is no technology transfer to our populace. One reason for this could be the lack of stipulating in the contract we signed with the multinational companies and enforcing the proviso that our indigenes ought to be trained as part of the contract. While we encourage a change in the way we do business with the multinational companies, we believe that the needed paradigm shift will occur and remain if we focus our efforts on the next generation. Consequently we now proceed to demonstrate to our children how the mathematics and sciences they learn in school can be applied daily in producing goods and services resulting in a vibrant economy.

What are the sciences? By this we include Physics, Chemistry, Biology, Zoology, Botany, Biochemistry, Computer Science, etc. Mathematics includes all branches like Algebra, Calculus, Statistics, Trigonometry, etc. We have been graduating students in these subjects over the years. What we have not seen is a corresponding increase in innovation among our people stemming from what they learned in school.

What is technology? According to Wikipedia, "*The word technology refers to the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, and methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function.*"

From this we can see that we are trailing in the area of applying our scientific knowledge in problem solving. All the scientific knowledge finds expression in engineering (Aeronautic, Chemical Civil, Electrical, and Mechanical etc.), medicine, and social sciences to generate a vibrant economy. As Dr. F. K. A. Allotery [6] put it, "It is now recognized that scientific knowledge is more essential for wealth creation of nations today than either capital or land. Physical resources like energy and materials are mostly depleted when utilized. On the other hand knowledge is inexhaustible".

We are going to demonstrate to our children that these subjects are not just for memorization and regurgitation during examinations, but applied to make life easier and more pleasurable today than yesterday. We hope to show that lasting wealth is created by industry as opposed to civil or political service employment.

The first thing we must do is select two abundant raw materials available in Akwa Ibom. We then use these two raw materials to show how employing mathematics and science to these raw materials leads to good employment, vibrant economy and wealth generation. In Akwa Ibom, there is plenty of sand (silicon) and plenty of palm trees. Can we build a strong economy on these? Yes we can. Here is how.

One always has to look around one's environment and identify a problem in dire need of a solution and develop a solution to the waiting sea of customers. We have done this in the past. For example during the Second World War, there was scarcity of kerosene for lighting lamps. Our grandparents invented Ikra and used it for lighting to save kerosene for the war effort. They used our own natural resources to do this. They took the dried petals from the coconut tree and put them on the bottom of the vessels in which they processed the cooked and mashed palm fruit as they manually squeezed the oil out of the mush. In the end, the dried petals had soaked up enough oil and were sliced into strands. Each strand was like a candle because it could be lit and left to burn and give light. You see we can invent but we have a poor record of improving our inventions. As an aside, the Ikra was named after Hitler who started the Second World War that led to kerosene scarcity!

One problem we have in Akwa Ibom is lack of reliable electric power. This adversely affects our children because they cannot study with kerosene lamps as effectively as they would with florescent electric light. How can we provide reliable electric light for each household and school?

If you go to the Periodic Table of the elements you learned about in Chemistry class, you can see the element Silicon (*See Figure 1*). From your knowledge of silicon chemistry you can develop and build solar panels that could produce clean electricity for our use.

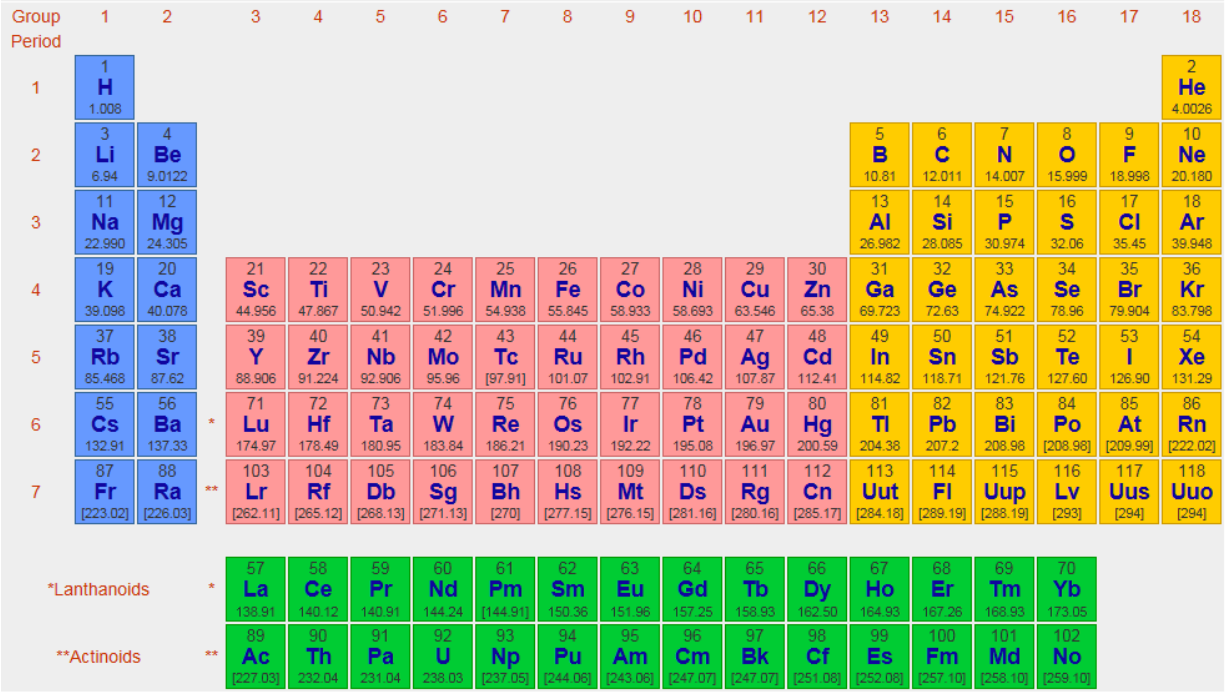
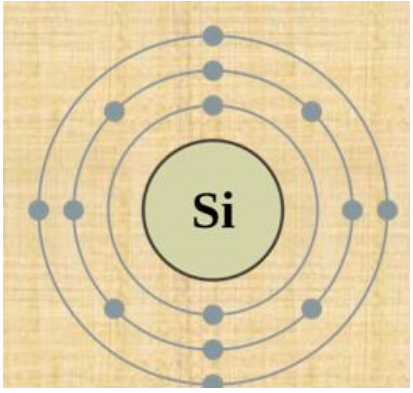


Figure 1 The Periodic Table of the Elements [7]

The production of a solar panel for electricity generation involves the knowledge of material science, chemistry, mathematics, and physics and material processing. Solar panel production begins with the silicon dioxide as the raw material. Silicon dioxide or Silica is reacted in an electric arc furnace (see the chemical reaction equation 1) to produce silicon. The chemical equation is given as,

$$SiO_2 + 2C \rightarrow Si + 2CO$$

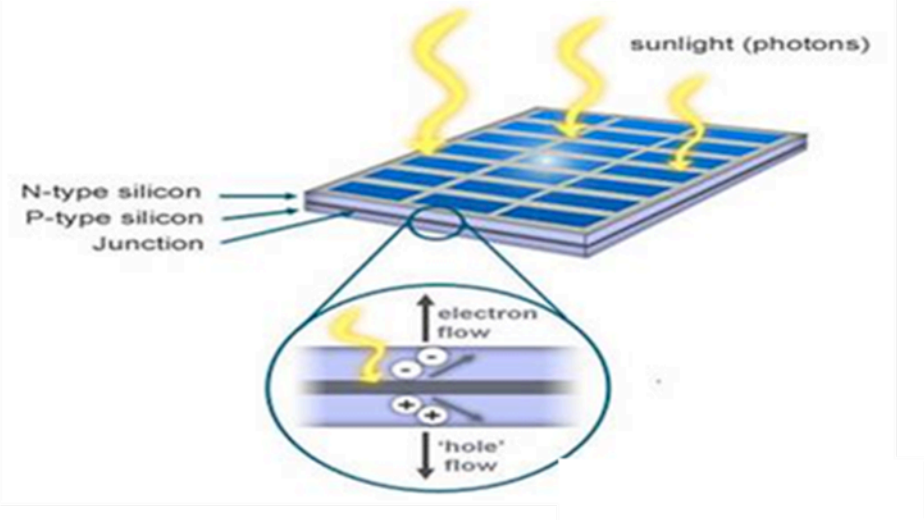
and the electron configuration of the silicon is given as,



1s 2 2s 2 p 6 3s 2 p 2

Figure 2: Electron Shell Diagram of Silicon

It must be borne in mind that silica in itself does not produce electricity, because the valence electron (see electron configuration of silica and the electron shell diagram of silicon above) is stuck in its shell. In order to knock off and free the electron from its stable state a mechanism must be introduced to enhance the free electron movement. This mechanism to induce the transport of the free electron is accomplished by doping the silica with some impurities on one side of the panel, and different impurities on the other side of the panel. The process of doping the silica with impurities is through etching. With proper technological application in material processing electrons will begin to flow; thus, generating useful electricity (see solar panel schematics and electric light in Pictures 6 and 7).



Picture 6: Solar Panel Schematics

Picture 7: Electric Light Produced via Solar Panel Technology

Thus by embracing solar technology, we can overcome the seemingly intractable problem of irregular power supply. So even in the villages not tied to the national electricity grid, our children can still study in a well - lit conducive environment.

Another abundant and renewable raw material is our palm tree. It is not a coincidence that this resource features prominently in the IPU logo below.

Picture 8: Ibibio People's Union, IPU Global Logo

The following Table that shows the products derivable from that tree further buttresses the importance of our palm tree.

Table 1
The Palm Tree as an Economic Engine

1	2	3	4		
Palm Tree	Palm oil	Cooking/baking, food coloring		Soap Glycerin, etc	
		Ikra (for lighting)			
		Fatty acids	Lauric acid Myristic acid Palmitic acid Stearic acid Oleic acid Linoleic acid		
		Wax	Candles		
	Palm Kennel	Kennel oil Kennel shell	Soap Fuel		
	Palm Wine	Gin			
	Akpeh eyop	Lye Fertilizer Animal feed	Soap		
	Nkwed	Fuel			
	Palm Fronds	Broom (ayang), fuel			

In short, this tree could be the engine of our economy as it is for Malaysia – see the paper of Emmanuel O. Egbogah [8] on "The Role of Technology in National Development". If we took the time to apply science and technology to process it from its raw form to value added more expensive products it is easy to visualize increased employment, less crime, more scholarship and less cultism from our students as well as increased sources of funding for research for the faculty in our Universities.

How can the palm tree be our economic engine? Take a look at the table above. Column 1 simply shows the tree. Column 2 shows products we have historically derived from the tree. Column 3 shows some things we did not realize were components of palm oil that can be further separated and exploited for added value products. Let us also point out here that our grandmothers knew that *akpeh eyop* could be used to make soap and used it during laundry.

Now take the fatty acid fraction. You need knowledge of analytical chemistry to be able to separate the raw oil into these components. You need knowledge of thermodynamics and chemical engineering to be able to commercially separate these components. The separate components are used in a variety of other chemical processes and command higher prices than the raw palm oil. Mathematical knowledge is necessary for the successful modeling of the separation (distillation, splitting) processes. Also required is the knowledge of organic chemistry to know how to utilize each component to make a useful product.

Let us discuss the making of soap which everyone uses, the lack of which was largely responsible for the longevity of the plaques during the Dark Ages in Europe (http://medievaleurope.mrdonn.org/plague.html).

We see above that one can get stearic acid from palm oil. In chemistry it is almost an adage that Acid + Base = Salt + Water. We can use this concept to make soap as shown by the following equation:

$2CH_3\text{-}(CH_2)_{16}\text{-}COOH + NaOH \rightarrow CH_3(CH_2)_{16}\_COONa + H_2O$ (equation 2)[9]
Stearic acid + sodium hydroxide → sodium soap + water

If one wanted to make liquid soap, you could use potassium hydroxide in place of sodium hydroxide and react this with a triglyceride from palm oil:

$C_3H(C_{18}H_{35}O_2)_3 + 3KOH \rightarrow C_3H_5(OH)_3 + 3KC_{18}H_{35}O_2$ (equation 3)[9]
Stearin + potassium hydroxide → glycerin + potassium stearate

Now we have our basic soap. We can improve upon this and add more value by incorporating an anti-bacterial chemical, fragrance, and so on. We are going to need knowledge of biochemistry to successfully do this. Then we will need to design an appealing package or container for the soap so that it will not only command a higher price but would also be in great demand.

Let us perform simple estimation of the economic value of what we have learned to do. Nigeria estimates her population at about 150 million people. Every one of these 150 million people use soap. If one can corner 5% to 10% of this market, the customer base easily is 7 to 15 million people. The reader can use any profit margin from N1, N10, N20 per bar of soap and estimate the profit that can be made. These are but a few examples of what our children can do with the knowledge of and application of the sciences and technologies.

There is one other major area of study and application that must be emphasized – Computer Science. Computers of all kinds and sizes have invaded practically every aspect of life. Computers now can control entire processes. This means that our youth must learn and master computer science. In fact Computer Science has leveled the playing field in an unimaginable way. It is the only area where one does

not have to have a lot of money to become a billionaire – yes billionaire. No other industry has created as many millionaires and billionaires of young people in their 20s as Computer Science. It is therefore imperative that we equip our children to compete in this field and create lasting wealth.

It should by now be crystal clear that what Akwa Ibom needs is for her citizens, young and old, to fully embrace science and technology and forgo the Civil Service mentality in order to build a robust economy and create lasting wealth. The only way to make this paradigm shift a permanent one is to inculcate in our young ones, the love and practice of mathematics, science and technology. The benefits of being a producing society include a vibrant economy, internship and job opportunities for youth, and research opportunities for University professors.

The following recommendations are made:

Embrace solar technology to overcome epileptic power supply so the kids can learn.

Emphasize computer science since it requires minimum capital to launch a business (example: writing code for Apps).

Hold annual contests where secondary schools compete to identify a local problem and develop a solution to it.

Encourage use of local renewable raw materials.

Launch a buy made in Akwa Ibom campaign.

References

1. http://en.wikipedia.org/wiki/Industrial_Revolution
2. http://en.wikipedia.org/wiki/Industrial_Revolution
3. http://en.wikipedia.org/wiki/Industrial_Revolution
4. http://en.wikipedia.org/wiki/Bessemer_process
5. http://en.wikipedia.org/wiki/Basic_oxygen_steelmaking
6. SCIENCE, TECHNOLOGY AND DEVELOPMENT, DR. F. K. A. ALLOTEY, KING/CHAVEZ/PARKS VISITING PROFESSOR THE UNIVERSITY OF MICHIGANANN ARBOR, MICHIGAN
7. http://webelements.com/
8. The Role of Technology in National Development, Emmanuel O. Egbogah, Executive Chairman, Emerald Energy Resources
9. The Soapmaker's Companion, Susan Miller Cavitch, p228