TRANSLATING SCIENCE INTO TECHNOLOGY:THE CHALLENGE FOR AFRICAN COUNTRIES

by

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1 INTRODUCTION

1.1 Historical Background

Several decades after gaining political independence from their colonial masters, beginning from the late 1950's, many African countries find their economic progress severely constricted by the unavailability of technical personnel. This situation has been exacerbated by the rapid progress of technology within the past two decades. For many of these countries, the big issue on the eve of independence was to find their own nationals who would effectively assume the technical positions which were invariably vacated by the erstwhile expatriate incumbents. The pressing challenge at that time was for these indigenes to essentially maintain the facilities and other public utilities which the expatriates had very suddenly abandoned. Within the past twenty years, many of these countries have also built several state-of-the-art facilities, like flour mills, power plants, dams, refineries, etc., which employed the currently most advanced technology. So these countries found themselves grappling with the challenges of maintaining old, existing facilities, and simultaneously, being thrust into the big league of cutting-edge technology. They were, technologically speaking, being called upon to run before they could walk.

This anomalous technical situation for many African countries had its roots in the often turbulent path along which the countries travelled towards nationhood. The movement for political independence had often been led by people whose education was mostly in the letters. While many of these African "founding fathers" had indeed distinguished themselves in the areas of literature, law, the arts, and medicine, in several of the best educational institutions in Europe and the Americas, there were comparatively much smaller numbers of technical professionals. Political agitation was understandably, quite often dominated by the one goal of securing independence. Consequently, little parallel attention was directed towards the development of indigenous cadres of technical personnel to run the countries' technical facilities once independence finally came.

In the immediate post-independence years, several of the countries attempted to alleviate the problem by sending large numbers of their citizens to both local, and foreign, higher institutions of learning to acquire the

requisite technical knowledge and skills. The problem is that merely getting a degree or diploma does not make one an engineer, or scientist. The newly acquired classroom principles can often be translated into actual, functional, competency only after years of highly focussed apprenticeship under an already qualified professional. Again, because of the circumstances, there often existed, only limited numbers of indigenous experts to provide the new graduates with the much-needed direction and maturation.

1.2 The Goal of This Paper

The goal of this study is to use the historical backdrop in Section 1.1 to examine some of the challenges that many African countries have faced in their accelerated transformation of science into technology. By science, I shall mean the systematic acquisition of knowledge about the physical or material world, as well as the knowledge itself, as they are taught in institutions of learning. By technology, I shall mean the application of science to design, fabricate, install, and operate facilities and plants to satisfy the physical needs of society. I shall further consider technology at two levels, namely, (1) *Basal Technology,* by which I mean the technical know-how required to maintain existing facilities, and (2) *High Technology,* by which I denote the technology required to build new plants. By this admittedly elastic definition, high-technology encompasses quite a wide spectrum of activities, for example, in the areas of aviation, nuclear energy, astronautics, petroleum extraction and processing, and communications. Furthermore, by the translation of science into technology, I shall mean the production of a sufficiently large pool of indigenous scientists and engineers, who will successfully translate the science concepts of the classroom into physical reality. Finally, the study concludes with some guidelines to these countries for most effectively continuing the technologization of their societies into the twenty-first century.

2 APPLICATION OF BASAL TECHNOLOGY

In the late 1960's to the mid-1980's, a term that was quite often used in the field of international development aid was "Appropriate Technology". It denoted technology that was presumably at the level best suited for developing countries, since they were not yet ready for the real thing. As Table 1 indicates, such a stratification of the countries into a technological hierarchy could hardly have been assailed.

Table 1. Selected Demographic Data - African Countries
Contrasted with Developed Countries

Column	2	3	4	5	6
Country	Pop. (Mil.)	Literacy Rate (Per cent)	Pupils/ Teacher	Engineers/ Scientists	Technicians
Germany	81.0	100.0	24	3,040,000	2,150,000
U.K.	58.1	100.0	23	3,038,000	2,102,000
U.S.A.	260.3	95.5	24	5,286,400	N/A
Ghana	17.3	53.5	53	N/A	N/A
Liberia	2.9	22.9	76	N/A	N/A
Nigeria	98.1	42.6	85	22,050	79,550
Zaire	42.7	61.6	72	N/A	N/A

Sources:

Columns 3 and 4: Reference # 2

Other Columns: Reference # 1

Column 3: Average for men and women

The data show that most of the developed countries have essentially fully literate populations. In the area of science and technology, they generally possess significant numbers of well-trained and competent personnel. The small class sizes in their educational systems ensure that their teachers are not overwhelmed in their didactic tasks. This in turn helps to fuel the production of yet more specialist personnel. The data for the African countries are in very sharp contrast. The literacy rates are generally much lower and their engineering and scientific manpower resources are by comparison quite minuscule.

Despite these glaring inadequacies, the newly emergent African countries, right from the attainment of political independence, have had to fulfil several technological obligations as sovereign states. By the application of *Basal Technology,* using their own nationals, these countries have had to address several issues, for example:

1. Running Existing Plants & Services;
2. Regulating National Industrial Activity;
3. Participating in International Technological Agreements;
4. Managing Major Accidents, Emergencies, or Natural Disasters;
5. Designing and Implementing Technological Curricula for their nations' educational systems.

In further elaboration of these specific examples, we will consider only items (1), (4) and (5). Many African countries have needed to accord greater attention to maintenance, the act of keeping existing plants and services in good working condition. That should have prevented many state-of-the-art factories, airlines, railway systems, shipping fleets, etc., from rapid dilapidation, as has often happened. Another area for concern is the management of major accidents, emergencies, or natural disasters. In the flurry of normal business and industrial activity, very few nations today can hope to avoid such incidents entirely. Disaster management activities are not often associated with technology although in reality they require considerable technological know-how to be employed under duress. The ready availability of machines and equipment, and the people to operate them successfully, may decide whether lives are saved or lost.

The one area in which the new African countries could have achieved the greatest impact on their technological development has been the area of curriculum reform. In many cases however, the curricula were fashioned after those prevailing in the former colonial countries, and only a modicum of local factors were incorporated. Another negative factor was that governments were often dominated by individuals who, like the pioneers of political agitation in the pre-independence days, had mostly non-technological education, and so could not fully appreciate the potential impacts of scientific and technological education.

In summary of the application of *Basal Technology*, it may be said that although different countries have succeeded to varying extents in attempting to meet these challenges, much needs to be done overall. Some of these areas of greatest concern will be outlined later in Section 4. In the next section, attention will be directed to high technology.

3 APPLICATION OF HIGH-TECHNOLOGY

It is almost paradoxical that the newly emergent countries of Africa should be concerned with *High Technology*, when they can barely successfully tackle *Basal Technology*. However, they must get on the technology bandwagon at its current position, and sometimes, this can mean switching from the stone age to the twenty-first century almost overnight. Such drastic changes impose additional burdens on the technical personnel in these countries. Typical areas which have undergone such rapid transformations include:

1. Building and Running of New Plants and Services;
2. Exploitation of Mineral Resources;
3. Entry Into New Technology.

The construction of new plants and services, like giant dams, international airports, and other infrastructural facilities, are essentially unavoidable because of their potentially positive impacts on economic development. The mineral exploration and exploitation industries quite often

command even greater urgency on account of the significant role that minerals and petroleum can play in any nation's economy. The downside is that these technological activities are quite often inseparably bound with severe environmental side-effects, which even the most technologically advanced nations are yet to successfully address. The new emergent countries have thus been faced with extremely daunting challenges.

4 GUIDELINES FOR ACTION

In this section we present some guidelines for the new African countries to pursue in the accelerated technologization of their societies. The first requirement for any meaningful attempt at building a credible corps of indigenous technological manpower is political stability. This does not mean the adoption of one political ideology as opposed to another. It means the existence of good, stable governments, ones that are responsive to the genuine needs of their citizens, and that will faithfully exercise their nations' sovereignty. Given this datum, the following specific courses of action should prove very beneficial.

4.1 Apply Local Perspectives

The first imperative for these African countries is to apply local, indigenous, perspectives to every endeavour. The area of medicine and health services is one example of how local factors have often been repudiated. When the nations' western-world educated doctors started arriving, traditional healing practices were simultaneously thrown out without the benefit of critical evaluation. It is amazing how western medicine itself has now started to examine, and sometimes even apply, the techniques and systems that the Chinese have known and used for thousands of years, while the Africans are going the other way and denouncing their traditions.

4.2 Educate The Minds and Hands

Education in the sciences, mathematics, and technology should be hands-on, and result-oriented, as opposed to the current emphasis on theory and just high examination scores. African countries must educate both the minds and hands of their students, so that more of them can eventually become effective problem solvers. Institutions of learning should be prevented from degenerating into diploma mills, but be encouraged to become spawning grounds for problem solvers. This calls for well-equipped laboratories, and the assignment of student projects from the earliest possible level. Every possible device should be employed to squeeze out every ounce of inventive talent in each and every student.

4.3 Keep The Schools Open and Running

Another area in which many African countries can ensure that their manpower pools grow steadily, is to ensure that their institutions of learning are all open and running at all times, so that the educational production line is never interrupted. Any school closures, except for the outbreak of disease epidemics, or other natural disasters, or acts of war, should be absolutely forbidden. It has been the custom of many African countries to close their schools for extended periods of time, usually by strike action of the teachers, and sometimes by the students themselves. Such ill-advised closures are very detrimental to the economic well-being of the countries affected and so must be avoided at all costs.

4.4 Invest on Overseas Technological Training

For many years to come it would be very good investment for African countries to continue to send their nationals abroad for scientific and technological education. Strong foundations can be laid at the beginning levels with well-designed and implemented educational systems, while selected students could be sent overseas to acquire in-depth and specialist skills. Engineers should also be routinely exposed to new skills abroad.

4.5 Stay Away From Super High-Technology

A prudent thing for many of the new emergent countries would be to stay out of active participation in super high-technologies like nuclear energy and genetic manipulation of life forms. It would be essential to send people for education and training in these areas so that effective links can be sustained with the participant countries. However, the actual construction of plants and facilities should be avoided until the emergence of sufficiently large scientific and engineering communities can be ensured. Just imagine what Chernobyl would have been had it occurred in an African country. And, remember Bhopal in India.

REFERENCES

1. Reddy, Marlita A. (1996) Statistical Abstract of The World (Gale/ITP)
2. Kurian, George T. (1991) The New Book of World Rankings, 3rd. Ed. (Facts on File)