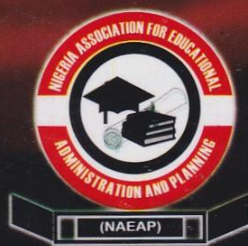


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Managing Inventions in Technical Education for Sustainable Development of Akwa Ibom State

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Abstract

The study examined invention management in technical educational institutions in Akwa Ibom State. The population consisted of Technical school teachers in Akwa Ibom State. There was no sampling as all the 236 teachers in the five technical schools in the state were involved in the study. Two null hypotheses were formulated and tested at 0.05 alpha level, using population t-test. Data collection was done using a structured instrument: Technical Education and Invention Management (TEIM) questionnaire. The two null hypotheses were retained, indicating that the organisation and staffing of technical education in the State does not facilitate invention and innovation for sustainable development. On the basis of this, it was recommended that the organisation and staffing of technical education be given a more serious attention to facilitate sustainable development of the state and nation.

Background to the Study

The poor economic condition of Nigeria is largely attributed to the failure to develop indigenous technology. The literature is full of accounts of Nigeria's ample human and natural resources. Nigeria has a variety of export crops – cocoa, groundnuts, palm products, cotton, timber, and rubber – in addition to its abundant food crops. It has rich mineral resources, notably oil and iron. Afonja (2006) pointed out that Nigeria has a significant proportion of the world's tin, columbite, and titanium. If these were exploited using indigenous inventiveness, the result would be a considerable acceleration of the country's technological development.

It is worthy of note that Nigeria invests relatively heavily in human resources, especially in technical training. During the 1980s,

great attention was paid to training intermediate and high-level scientific, technological, and technical personnel in universities, technical colleges, polytechnics and trade centres. Besides, more technical institutions are being established in the country every year with a steady increase in students' enrolment.

Despite these, food-processing machines are imported, as are many finished products, even though local products could as well supply the need. The need for Nigeria to look inward into invention and innovation management cannot be over emphasized. As observed by Tiffin (2007), invention, the initial step of innovation, is much common in Nigeria than people realize. If they were properly managed and backed by appropriate public policies, some of them would undoubtedly become huge entrepreneurial ventures.

Technical education in developed countries is invention-oriented. This should be adopted by developing countries. One of the goals of technical education in Nigeria at the secondary school level is "the giving of training and imparting of the necessary skills to the learner, who shall be self-reliant economically (FRN, 2004). This is to be achieved through industrial training/ productive work; small business management; and entrepreneurial training. These are meant to enable the individual develop creativity that can lead to invention and innovativeness.

The development and management of inventions in education depends largely on the state of education at any given level. In Akwa Ibom State, a number of breakthroughs have been recorded in the area of invention by students of technical colleges. For instance locally made battery charger and circuit breakers have been invented by students of technical colleges in the state. This feat was held high by the State Government, groups and individuals. Today, these products are neither heard of nor found in any electrical shop in the state because of poor management and inadequate attention. This study therefore examines invention management in technical education as the basis for sustainable development of Akwa Ibom State.

Technical Education and Invention Management

There is a widely held belief that inventiveness is the most needed ingredient for the Nigerian educational system. Although some changes and innovations have taken place in the educational system

since independence in order to decolonize the system, catch up with the changing structure of post-colonial society, and keep abreast with modern trends resulting from globalization, such have not been properly managed and implemented (Alao and Obilode, 2000).

Going by the dictionary definition, the New Webster's Dictionary (2000) defines invention as "the ability to think things up", while management according to Peretomode (1999) is "the job of getting things done through people". It is the guidance, leadership, and control of the efforts of a group of people towards some common objectives (Sherleker, 1984). It involves the application of the processes of planning, organizing, staffing coordinating, controlling and evaluating human and material resources towards the realization of set goals and objectives. Invention management therefore could be seen as the application of the processes of planning, organising, staffing, coordinating and controlling of human and material resources in facilitating the ability of people to think things up for the wellbeing of humanity. It entails the creation of conducive environment for people to successfully use their creativity in the production of goals and services that can benefit human beings.

Although creativity and invention is not restricted to technical education, technology education is the means by which man controls and modifies his natural environment (Nwokolo, 2002). This is dependent on the effective management of the available technical knowledge. Successful invention is a function of effective resource management and the creation of an environment that can facilitate creativity.

Invention, according to Drucker (1985) is composed of two parts: the generation of an idea and the conversion of that idea into useful application. The invention process covers all efforts aimed at creating new ideas and getting them to work. Managing invention entails the organization and direction of human and material resources towards effectively creating new knowledge; generating technical ideas aimed at new and enhanced products/services; developing those ideas into working prototypes; and transferring them into manufacturing, distribution and usage (Quinn, 1999).

Invention stimulates entrepreneurship and overall economic activity. Flemings (2006) defines invention as a focused application of the human mind to the world that yields an original creation with

practical use. Innovation is the practice of bringing inventions into widespread usage, again through creative thinking, investment, and marketing. In order to stimulate invention, careful attention has to be paid to education. Invention requires a lot of knowledge. It requires paying attention to freedom of inquiry, to allow students find their own ways and develop their own creative minds. This is particularly important, when it comes to enhancing inventiveness in developing countries where learning facilities are inadequate. In addition to education, we need to stimulate invention and innovation by showing that society values those who succeed in these fields.

As observed by Salter (2006), invention is not a linear process, from idea to product, to economic impact. Rather, invention is a complex interaction between human creativity, technology and the marketplace, and iteration must typically happen between all three realms before an invention has a significant economic impact. For any invention to be successful, effective management is required.

Proper management of invention in education remains the key to sustainable development of any nation. Sustainable development, the practice of improving human life while protecting the environment, is perhaps the most important and the most daunting long-term challenge that any nation faces. However, inventions and technological innovations have proven to be the crucial elements needed for sustainable development of modern societies, although some key new technologies are known to have caused enormous damage to the global environment. Invention and innovation for sustainable development is not just about developing new technologies. It involves new processes and new ways of solving old problems. Creative thinking remains the rubric. It has been observed that developing countries tend to stifle innovation and creativity. This is typically due to a combination of factors: insufficient financial resources, lack of role models, education systems that do not inspire or value creativity, and social/political environments that discourage creativity, invention and entrepreneurship.

In order to realize the goal of sustainable development, prospective inventors should provide answers to such key questions as: What kinds of new products and services are needed to create sustainable livelihoods in the community? How can we stimulate creative thinking in local environments in response to local needs? How

can we raise the level of awareness of invention and innovation as an answer to the problems stemming from sustainable development? Sustainable development has different meanings and implications in different parts of the world. It may not only imply inventions for conserving energy and reducing pollution, but also innovations that can give impoverished people all over the world the tools they need to create "sustainable livelihoods" - jobs that produce basic products and services for the local economy, generate income and purchasing power, and also provide dignity and meaning to peoples' lives.

Result-oriented management of invention in education hinges on two basic dimensions: organisation and staffing: each subject to managerial influence and control. Improved management of these dimensions is essential for achieving successful invention in technical education. Effective organisation of the invention process is a key factor in successful invention management. The management team in our technical colleges should be able to forecast the future of the institutions in relation to the community and give direction to the institution. The team should be able to establish the institutional structure of authority, responsibilities, tasks, and build up human and material resources for effective functioning of the institution.

As education managers, the school management team should be able to:

- set objectives for using the available school resources;
- formulate plans for achieving these objectives;
- staff the institution with the required personnel;
- supply incentives to stimulate creativity and hardwork; and
- liaise with the appropriate authorities to support every worthwhile project undertaken by the staff and students.

The managerial issues involve coordinating a number of specialists of different disciplinary backgrounds towards achieving, within previously estimated development budget and schedule, a predefined technical output at competitive production costs. Effective managerial practice involves tight control, elimination of duplication, strong financial criteria for resource use accompanied by formal evaluation.

Managerial behaviour can affect staff creativity, inventiveness and productivity. Effective individual and group supervision, including proper maintenance of group diversity and task challenge are likely to

produce useable ideas. The design of organizational structures that will enhance technological innovation requires focusing on both the organization's inputs and its outputs. Effective invention management requires appropriate technical and market information inputs. Managerial research has repeatedly demonstrated that 60 to 80 percent of successful technical innovations seem to have been initiated by activities responsive to "market pull," i.e. forces reflecting orientation to perceived need or demand (Utterback, 1994). A recent study of basic research in industry, among many other interesting conclusions, produced the unsought finding that most inventions come about as a result of the recognition of a market need or opportunity (Fernelius and Waldo, 2000). They concluded that while the push of new technology is also important, it plays a distinctly secondary role.

Invention management also involves patenting. There have been several claims of inventions and the development of appropriate technologies that could benefit the local economy by Nigerian educational institutions. However, many of these inventions have not been utilized, and they remain in the confine of the institutions. Oyewale (2005) attributed the non-exploitation of these inventions to lack of information on their existence to prospective users. Patenting of the inventions could serve as an effective means of disseminating information about them, and at the same time encourage industrialists to invest on the inventions because they are under legal protection.

Invention management requires adequate staffing. Two primary issues arise with regard to staffing technical education for effective invention management: what kind of people needs to be involved for effective technical education development; and what managerial actions can be taken to maximize their overall productivity. With regard to people requirements, Roberts and Fusfeld in Wonecott, Whalenn and Bahree (2003) examined a number of "critical behavioral roles," not just technical skills, that must be possessed and practiced by the people involved in technical education development to include:

- i. Idea generation
- ii. Entrepreneurship or product championing
- iii. Programme management
- iv. Gate keeping
- v. Sponsorship

Idea generation

Management of invention involves the creative contribution of new insights that both initiate projects and contribute to problem solving. Ideas can be drawn from the "market pull" of sensing real or potential customer needs or demands, or from the "technological push" of envisioning the possible extension of technological performance of a material, component or system. Ideas include not just those which lead to project initiation, but also the many throughout an innovation-seeking endeavor which contribute importantly towards invention or innovation outcomes. Idea generators for invention may be scientists or engineers, sales or marketing persons, or even managers. Although individual differences that are either innate or developed over long periods do account for many of the distinctive characteristics of effective idea-generators, many sources of heightened idea creativity arise from managerial influences resulting from the internal organizational climate or environment and especially from supervisory practices. This explains the need for effective managerial behaviour in the invention process. As observed by Bravin and Stecklow (2003), there are significant differences between "idea-havers" and "idea-exploiters"--those who come up with ideas and those who do something with the ideas they have generated. This holds true whether the ideas are born in schools, government laboratories or in industry. For effective management of invention in technical colleges, the management team should comprise of persons that can generate, accommodate and manage ideas effectively.

Entrepreneurship or Product Championing

Entrepreneurs advocate and push for invention. They take ideas, whether their own or others', and attempt to get them supported and adopted. Most major studies of factors affecting invention success have found the active presence of a product champion to be a necessary condition for project success (Rubenstein, Chakrabarti, O'keefe, Souder and Young, 2006). For instance, the late Ken Estridge gained widespread reputation as the product champion behind IBM's successful development and launch of its personal computer. The entrepreneurial role is a critical factor in invention and invention management. People with entrepreneurial spirit should be encouraged to remain in our technical colleges. Lehr (1999) argues that strong entrepreneurial

efforts are needed even within institutions that have long traditions of fostering entrepreneurship, in order to sustain the inventive process.

Programme Management

A third required role in effective invention management is programme management. The programme manager or leader supplies the support functions of planning, scheduling, monitoring and control, technical work supervision, business and financial coordination relating to the project (Katz and Allen, 1985). This is the one "role" which is also usually an assigned job in the institution, the other roles being incidental to an individual's specific work assignment. The different departments in the technical colleges should be assigned capable programme coordinators or managers. They serve as directors and facilitators in the invention process.

Gate keeping

Gatekeepers or special communicators are the fourth critical role identified in the invention management process. They are the link-pins who frequently bring information and messages from sources outside of a project group into that group (Allen, 1997)). These human bridges join technical, market and manufacturing sources of information to the potential technical users of that information. Gatekeepers may bridge one technical group to another within the institution, or may link school research activities to a technology center. Although such individuals are rare, they are easily identified (Gartner and Naiman, 1996). Effective "bridgers" are found to be interpersonally able (e.g., good listeners), have depth in at least one discipline, have a wide range of interests, and be oriented towards problem solving. They are ended as liaison officers in the invention management process.

Sponsorship

The final key role is that of the sponsor or coach, performed usually by a more senior person who is neither carrying out the invention itself nor is directly and personally aggressively championing the change. The role is one of providing encouragement, psychic support, facilitation to the people involved in the task implementation. They also help in harnessing the resources needed by the inventors (Roberts, 1998). Sponsors are often needed for idea generators, project managers, and

especially for entrepreneurs. This is needed to provide the necessary support to the inventors.

Effective development and management of technical education requires recognition of these differentiated roles in order to create and implement appropriate people management processes, including recruiting, job assignment, personnel development and training, performance measurement and rewards which are the prerequisites for effective invention management.

Objectives of the study

The study sought to:

- determine the impact of organization and supervision of technical education on invention management in Akwa Ibom State.
- determine the impact of staffing of technical education on invention management in Akwa Ibom State.

Research Hypotheses

- Ho₁ There is no significant impact of organization and supervision of Technical Education on invention and innovation in Akwa Ibom State
- Ho₂ There is no significant impact of staffing of Technical Education on invention and innovation in Akwa Ibom State

Methodology

Teachers of Public Technical Schools in Akwa Ibom State constituted the population of the study. As at the time of this study (August, 2009), there were 236 technical school teachers in the 5 Government Technical schools in the State. There was no sampling as all the 236 teachers were involved in the study.

A structured questionnaire: Technical Education and Invention Management (TEIM) was developed and used for the study. The instrument was made up of two sections: Organisation of Technical Education and Invention Management; and Staffing of Technical Education and Invention Management with five items in each section. It was pre-tested to establish its reliability level which stood at 0.773.

Results

The data collected were analysed using the population t-test.

Hypothesis 1

There is no significant impact of organization and supervision of Technical Education on invention and innovation in Akwa Ibom State

Table 1

Population t-test Analysis of the Impact of Organisation and Supervision of Technical Education on Invention and Innovation

N = 236

Variable	No. of Items	X	SD	t
Impact of Organisation and Supervision of Technical Education on Invention and Innovation	5	18.72	1.89	1.41*

* Significant at 0.05 level; df = 235; critical t-value = 1.96.

The obtained t-value was 1.41. This was tested for significance by comparing it with the critical t-value at 0.05 alpha level with 235 degrees of freedom. The obtained t-value of 1.41 was less than the critical t-value of 1.96. Hence, the null hypothesis was retained. The implication is that there is no significant impact of organisation and supervision of technical education in Akwa Ibom State on invention and innovation.

Hypothesis 2

There is no significant impact of staffing of Technical Education on invention and innovation in Akwa Ibom State

Table 2

Population t-test Analysis of the Impact of Staffing of Technical Education on Invention and Innovation

N = 236

Variable	No. of Item	X	SD	t
Impact of Staffing of Technical Education on Invention and Innovation	5	18.23	1.45	0.99*

* Significant at 0.05 level; df = 235; critical t-value = 1.96.

The obtained t-value was 0.99. This was tested for significance by comparing it with the critical t-value at 0.05 alpha level with 235 degrees of freedom. The obtained t-value of 0.99 was less than the critical t-value of 1.96. Hence, the null hypothesis was retained. The implication is that there is no significant impact of staffing of technical education in Akwa Ibom State on invention and innovation.

Discussion of Findings

Data analysis in hypothesis one indicated no significant impact of organisation and supervision of technical education on invention and innovation management in Akwa Ibom State. The calculated t-value was less than the critical t. This led to the retention of the null hypothesis. The implication is that technical education in Akwa Ibom State is not adequately organized and supervised. This does not augur well for effective management of invention and supervision. This finding is supported by Tiffin (2007) which observed that invention, which is the initial step of innovation, is much common in Nigeria than people realize, but that it is poorly managed and deprived of appropriate public policies. Information about inventions are lacking and this leads to their non-exploitation and subsequent extinction (Oyewale, 2005). Technical colleges are starved of funds, equipments, and needed personnel. This hampers effective organization and supervision of projects that can lead to inventions and innovations.

Analysis in hypothesis two equally revealed no significant impact of staffing in technical colleges on the management of invention and innovation. The obtained t-value was less than the critical t. The null

hypothesis was consequently retained. It implies poor staffing of technical colleges. This cannot facilitate effective management of inventions and innovations. Invention management requires specialists in different fields (Bahree, 2003). It is these experts that will liaise with the managerial team to plan, design and bring about inventions and innovations that will meet the needs of the community. The staff need constant training and retraining to update their knowledge and exposure to the outside world. Such knowledge and exposure are needed for effective management of the invention process.

Recommendations

On the basis of the conclusions drawn, the following recommendations are made.

- The organizational structure of technical colleges in Akwa Ibom State should be re-visited in line with what is obtained in industrially developed countries.
- Supervisory practices should be more intensified and regularized in technical colleges. Projects should be monitored right from inception, and followed up till completion.
- The staffing needs of technical colleges should be studied and provided for. This is the only way projects can be effectively supervised and managed.
- Personnel training and development should be embarked upon regularly to keep the staff abreast of friends and developments in their various fields. This will equip them with the necessary tools for effective management of invention and innovations in the institutions.
- Necessary facilities, tools and equipment should be made available at all times in these institutions to improve the working environment and facilitate goal attainment.

Conclusion

Based on the findings of the study, the following conclusions were drawn.

- The organisation and supervision of technical education in Akwa Ibom State does not facilitate the management of inventions and innovations in the institutions.

- Technical colleges in Akwa Ibom State are poorly staffed. They lack the right calibre of personnel needed for effective management of inventions and innovations for sustainable development of the state.

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