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# GENERATION, PATENTING AND EXPLOITATION OF INVENTIONS IN SELECTED ACADEMIC DISCIPLINES IN NIGERIA

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ABSTRACT

This paper presents the result of a study on generation, patenting and exploitation of inventions in three academic disciplines in Nigerian universities and three research institutes. The study involved 30 researchers and 15 departments/faculties in seven universities as well as three research institutes and 15 industrial firms. The result indicated that some inventions/research breakthroughs had been generated in Nigerian universities and research institutes, but few of these had been patented. Most of the researchers were ignorant of matters relating to patents and government statutes on ownership of patents that may be generated from government-sponsored researches. The researchers did not consult patent documents as basis for further research. The promotion of technological entrepreneurial culture within the institutions/institutes, offering of part-ownership of patents to researchers and the institutions/institutes, and provision of patent education in the universities are recommended, to address the problems in the institutions.

**Keywords**: *University, research, invention, industry, patent, royalty, Nigeria*

## 1. INTRODUCTION

An invention is a new product or process that is developed for the first time, and it can be copied and produced by other people. What could prevent an invention from unlawful reproduction is the legal protection placed on it by patent, or lack of know-how for its production, which may be a trade secret (MacBryde, 1997). A patent is an exclusive right granted to an inventor for an invention, and it precludes unauthorised people from using it. Like a scientific publication, the patent is an intangible asset, but it gives its holder a monopoly and it has market value, which a scientific publication does not (Papon and Barré, 1996). While applying for patent, detailed information about the invention is provided by the patentee. Such information is made available for industrial exploitation under the authorisation of the patent owner. Patent information could also be assessed to provide basis for new reasoning, or the foundation for new researches into gaps that may be identified in the documents.

From two universities in Nigeria at independence in 1960, several others have been established, and as at 2011, the Federal Government of Nigeria had established a total of 36 universities. Various state governments have established another 36 universities, while 45 private universities have also been established (NUC, 2011). As at 2008, 68 research institutes that carry out research and development (R&D) in specific fields have also been established ((NUP, 2008). These institutions have produced some inventions and technologies that can be protected through patenting.

To date, most of the inventions remain unexploited, possibly because they were not patented. As it is difficult for innovators to access finance without intellectual property protection (DTI, 2003), many of the inventions remain non-commercialised. Patenting the inventions could bring them to the public view, whereby they can be acquired for exploitation. The number of inventions that the institutions claim to develop notwithstanding, Essien (2006) reported that research/academic institutions in Nigeria submitted about 11% of the patent applications received by the National Office for Technology Acquisition and Promotion (NOTAP) between 1999 and 2005.

UNESCO (1994) reported that government and project officials in Nigeria knew little about the commercial value of patents or how to tap information from patent documents. Could the same be said of researchers in Nigerian universities and research institutes? This paper therefore discusses how the understandings of patent issues by Nigerian researchers in three academic disciplines affect the patenting and exploitation of their inventions.

## 2. LITERATURE REVIEW

An invention is a newly generated idea or technology, which is created for the first time (Oyewale, 2010). It could also be an improvement of an existing technology. Thus, an invention can be a completely new product that contains a new technology and/or design, or an existing product, whose functions have been greatly improved by structural, material or process changes (White and Liu, 1997); but more often, an invention could be a combination of existing technologies (Hauser, 1998). Typically, inventions are fruits of R&D activities (Reich, 1989).

Technology, which is embedded in an invention, like information cannot be concealed forever (Jones and Lall, 1998), and whenever a technology is developed, it is prone to being reproduced by other people. Therefore, new technologies need to be protected through patenting. Patents are an exclusive right issued by authorised bodies to inventors to make use of and exploit their inventions for a limited period of time (Khan and Dernis, 2006). To obtain patent on an invention, an inventor would apply to the national or regional patent office disclosing detailed information in respect of the invention and pay a prescribed fee. The cost of applying for patents could be high. For instance, Murashige (1997) indicated that the cost of filing a typical biotechnology patent application in the European Patent Office and requesting for an examination is about $10,000. However, for an invention to be patentable, it must satisfy certain criteria - novelty, non-obviousness and industrial applicability (WIPO, 1999).

The novelty condition implies that the invention should possess new characteristic(s) which is (are) not known in the prior art, i.e., the body of existing knowledge. However, publishing information on an invention by the inventor may not necessarily destroy its novelty, if the inventor files patent application within a period of grace of the disclosure, which is six months in Japan and one year in Australia, Russia and the United States of America (USA) (Arnold, 1996; Gao, 2006; OECD, 1997). Similarly, it is possible to patent an invention and later publish information on the invention in learned journals. For instance, CIPO (2006) indicated that 70% of the information contained in patents does not appear in any trade journal for at least five years after the patent has been granted. Furthermore, WIPO (Publication No. 849(E)) indicated that the patent of Baird's television was published in 1923, but it took five years to be disclosed in other forms of literature, while Whittle's jet engine that was patented in 1936 was not disclosed in other forms of literature until 10 years after. Non-obviousness demands that the invention must show an inventive step, which could not be deduced by a person with average knowledge of the invention's technical field. The invention must also be subject to industrial exploitation and of practical use.

Upon submission of an application for patent, the patent office conducts a search in various patent data banks in IP offices worldwide, to establish that the invention is novel. On average, the time lag between application and grant/approval of patent is about three years in the USA, five years in Europe, and seven years in Japan (Arai, 1999). The search takes a long time because it involves scanning through millions of patent documents. When granted, the patent provides the inventor the exclusive rights to commercially exploit patented inventions for a period of time, generally about 20 years (WIPO, 1997). After the expiration of the protection period, the information in the patent document falls into public domain, and is freely available for commercial exploitation by everybody.

Worldwide, governments fund considerable amounts of research activities, which produce inventions. The patents obtained from such inventions can be held by the state, the institution/institute, or the researcher(s) that develop the inventions. In the USA, Bayh-Dole Act of 1980 relaxed government ownership of patents that are generated from government-funded R&D, and empowered academic institutions and small businesses to retain title to the patents. The Act was noted by OECD (1998a) to be an important factor for the seven fold increase in university patents over a period of 20 years. Other countries have been emulating the American measure. For instance, Japan assigned 50% of patent rights on publicly-funded inventions to researchers involved in developing such inventions (OECD, 1998b). Nigerian government is also moving in this direction. For instance, the Public Service Rules of the Federal Republic of Nigeria (FRN, 2008) indicates that the power to determine a government employee's right to the patent on an invention developed in the course of the officer's employment is vested in the Head of Government, who shall determine whether the officer shall be allowed controlling right in the patent or not. The Head of Government is also empowered to determine whether an award shall be made to the officer, the amount thereof, the share of royalties to be reserved to the government, and that to be granted to the officer.

Beside government-sponsorship of research, industrial firms may also do so. The firms may enter into contract, sponsored or co-operative research with universities or research institutes. When these collaborative activities are undertaken, the company or companies provide finance, technical resources, and/or personnel for the researches being conducted. In exchange, the company or companies receive title and licensing rights to the research findings (Dorf, 1988; USDC, 1989).

To enable them manage the patents that are generated by their researchers, universities develop patent policies that stipulates ownership of the patents and disbursement of the ensuing royalties from them. In designing patent policies, WIPO (Publication 848E) suggested that the institutions should aim at recovering all expenses associated with patent application and exploitation. Thereafter, the net income is shared among stakeholders that may include inventor's research group, faculty, university, patent, research and scholarship funds. Howells *et al* (1998) reported that in the University of Newcastle upon Tyne, if a patent is licensed, the disbursement of revenue from the invention is shared between university and inventor(s) as follows:

i. After legal costs, first £5,000 of Intellectual Property (IP) income goes to the inventor(s);
ii. The next £200,000 of IP income is split as follows:
   - 50% to the inventor(s);
   - 25% to the department(s) of the inventor(s); and
   - 25% to the university.

In Nigeria, the Office of Registration of Patents and Trade Marks is located in the Federal Ministry of Commerce and Tourism (Oyewale, 2010). Another government agency that is involved in patent activities in Nigeria is the National Office for Technology Acquisition and Promotion (NOTAP), which was established in 1979 (NOTAP, 2010). In the discharge of one of its mandates, NOTAP files patent applications and pays the prescribed registration fees on behalf of Nigerian applicants. Between 1999 and 2002, NOTAP filed 25 applications at the patent registry out of the 58 applications that were submitted to the office (WIPO, Best Practices, NOTAP).

Because of their tight work schedules and the waiting time before patents are granted, researchers are often discouraged from patenting their inventions. To address this problem, interface agencies such as Industrial Liaison, Technology Transfer or Patent Management Offices are established. The offices among other things, collate the inventions/research findings, process their patenting, negotiate their licensing and manage the intellectual properties of their parent institutions (Oyewale, 2005). Bremer (2001) reported that institutions that have technology transfer programmes in the USA increased from 30 in 1972 to 275 in 1977, while Howell *et al* (1998) indicated that 60 Industrial Liaison Offices were established in the United Kingdom universities within five years preceding 1989.

Starting with 15 in 2006, the World Intellectual Property Organisation (WIPO), through NOTAP established Intellectual Property Technology Transfer Offices (IPTTOs) in Nigeria (Adekoya, 2008), and by 2011, 30 of them have been established, 20 in universities, seven in polytechnics and three in research institutes (Bindir, 2011). Functions of the offices include refocusing R&D projects of their host institutions and making them more entrepreneurial. They are also expected to coordinate and link R&D

activities of the institutions to industry needs, and patent and market inventions of their host institutions (Isoun, 2006).

While patents preclude unauthorised industrial exploitation of inventions, they allow the use of the information therein for research without having to pay royalties. Through the information function, the patent system furnishes detailed information in patent documents to members of the public on request (WIPO, 1997). Such information can be used as the basis for further research activities for the development of new products and/or processes. This may arise through researches into gaps that are identified in the documents, the adaptation or improvement of the original invention to satisfy other perceived needs of a market, or the discovery of a different technical solution to resolve the same problem. WIPO (1997) indicated that 36, 9 and 6% of search requests made in 1991/92, 1993/94 and 1995/96 respectively were made to form the basis for R&D activities. In Nigeria, such information can be accessed from the Patent Information and Documentation Centre (PIDC) that WIPO established in NOTAP in 1992 (Essien, 2006). This service is also offered by the IPTTOs (Adekoya, 2008).

## 3. METHODOLOGY

The study focused on three academic disciplines namely Food Science and Technology (FST), Pharmaceutical studies and Metallurgy and Material Science (MMS) in universities and research institutes in Nigeria. Data were collected with two sets of questionnaires that were designed for the study. Some of the questionnaires were hand-delivered, while others were posted, or sent by courier to the selected respondents some weeks before visiting the respondents for their retrieval. One set of the questionnaires each, was given to three research institutes and relevant departments or faculties of seven universities in Nigeria. These university departments and faculties, and the research institutes that responded to the study are hereafter collectively referred to as Education and Research Organisations (EROs). A second set of questionnaire was administered on two senior researchers in the departments/faculties of the universities and research institutes through their Heads of Departments and Deans.

Altogether, 45 sets of questionnaires were administered to the selected respondents. Out of these questionnaires, 32 (71%) were retrieved at the expiration of data collection. The distribution of the retrieved questionnaires is as shown in Table 1. Out of a total of the 45 questionnaires that were distributed, 32 (71.1%) were retrieved. This number was made up of 11 organisational responses and 21 from researchers. The raw data gathered with the questionnaires were analysed using frequency distribution and percentage. The percentages used in the discussion below were based on the number of respondents who answered specific questions, on which the discussions were based. The results obtained were interpreted and inferences drawn from them.

## 4. RESULTS AND DISCUSSION

### 4.1. Generation and Exploitation of Inventions of Nigerian Institutions/Institutes

Analysis of the data shows that the government provides almost all R&D funds for Nigerian educational institutions and research institutes. In addition to government sources, 40% of the ERO and 20% researchers claimed to have obtained funds from various categories of industrial firms, individuals, foreign government agencies and international organisations.

About 82% of the EROs and 91% of the researchers claimed they had some inventions/research breakthroughs. The EROs and researchers claimed their research results are regularly presented in conferences and published in learned journals and technical reports. Furthermore, about 55% of the ERO and 52% of the researchers claimed their research findings were being used by industrial firms. However, about 36% of the ERO and 48% of the researchers suggested that the lack of awareness of their research findings might be responsible for their low utilisation by industrial firms. These responses possibly indicate the existence of information gaps between Nigeria's researchers and industrial firms.

The gaps could be bridged through patenting of the inventions, as patent documents publicise the inventions/research results to potential users. WIPO Publication No. 849(E) indicated that technology transfer centers established the fact that patents are often the best way of disseminating technologies. This is because patents encourage industrial firms to invest in developing and commercializing such technologies, since they are legally protected. Users of the patented technologies may not be limited to countries of origin, as foreign industrial firms that see economic potentials in the technologies may be interested in their exploitation. This assertion is confirmed by one of the EROs, whose patent was being exploited by a foreign firm, to which it is licensed.

Two Nigerian examples of patented inventions that have been exploited by industrial firms are the Yam Pounding Machine and NIPRISAN/NICOSAN. The Yam Pounding Machine was patented by the Obafemi Awolowo University, Ile-Ife in Great Britain (Makanjuola, 1975-76), while NIPRISAN/NICOSAN was patented by the Nigerian Institute of Pharmaceutical Research and Development in the USA Oyewale, 2008; Wambebe, 2007). Industrial exploitation of patents generated from academic research in Nigeria is scanty when compared with what obtains in the developed economies. For instance, Wallmark (1997) reported that 417 inventions were patented by staff and students of Chalmers University of Technology in Sweden between 1943 and 1994, and about 50% of the patents have been used for start-up of new spin-off companies and for supporting their growth, while the other 50% were being exploited by established non-spin-off firms.

### 4.2. Patenting of Inventions in Nigerian Institutions/Institutes

About 27% of the EROs claimed they had patented some of their inventions. Applications for patent had also been filed by about 5% of the researchers at the time of the study. About 25% of the researchers that gave reasons for not patenting their inventions claimed ignorance of the procedure of applying for patent, while about 8.3% claimed the procedure was difficult. The researchers' ignorance of the procedure for patenting of inventions, and by extension, being unaware of possible assistance from NOTAP, was the most prominent of the reasons given by the researchers for not patenting their inventions. This inadequate knowledge about patent matters could be a reflection of poor patent education in Nigerian institutions.

Drawing from the report of Oyewale et al (2007), about 6.5% of Nigerian researchers claimed that government sponsorship of their researches was one of the reasons for not patenting their research results. But this should not prevent the inventions from being patented. The institution/institute where the patent is developed could be authorised to apply for patent on behalf of, and own the patent in trust for the government.

About 27% of the researchers also indicated that the research results were already published; hence they could not be patented (Oyewale et al, 2007). This response shows the ignorance of the researchers, because publishing does not preclude an invention from being patented, neither does patenting preclude information on an invention from being published. For instance, it is only when information on an invention had been disclosed for over six months in Japan or 12 months in the USA that the invention cannot be

patented (Arnold, 1996; Gao, 2006). Furthermore, the inventor could file patent applications for the invention first; and thereafter publish information relating to the invention at a later date (WIPO Publication 848E).

The need for refinement or further developmental efforts was claimed by some researchers to have hindered them from patenting their inventions. Delays in applying for patent could sometime result in forfeiture of the patent right to other persons or organisation who file patent application first. This could occur, because in Europe and in most other countries the party that first files the patent application is entitled to the patent; whereas in the USA, the first person to conceive the idea (not who first publish or apply) will prevail in obtaining the patent, even if the patent application is filed later (Arnold, 1996). The study further revealed that about 5% of the researchers were not interested in patenting their inventions, but only interested in making their inventions freely available to the public. This attitude is not peculiar to these researchers, as the Millennium Project Report (2004) reported same.

### 4.3. Filing of Applications for Patenting Inventions/Research Results

About 73% of the EROs and 86% of the researchers gave their views on who should file applications for patents. Among these respondents, about 38% of the ERO and 44% of the researchers indicated that researchers themselves should apply, while about 63% of the ERO and 39% of the researchers indicated the institutions/institutes should do the processing. Furthermore, 17% of the researchers indicated that such processing should be the responsibility of the National Universities Commission, which supervises the activities of Nigerian universities, and the supervisory ministries of the research institutes.

It is appropriate for the researchers to process the patenting of their inventions; but their tight schedules, the administrative bureaucracy involved in the processing of patent application and the waiting period before patents are granted might discourage them from doing so. To resolve this dilemma, the institutions could file patent applications on behalf of the researchers through the IPTTOs that were recently established in the institutions. As earlier stated, one of the mandates of the offices is to file applications for patents and market inventions of their host institutions.

### 4.4. Approaches on Regulation of Rights of Ownership of Patents from Government-Sponsored Research

The study revealed that the approach used for the regulation of ownership of patents generated from government-sponsored researches in Nigerian institutions/institutes was not well known to the researchers, as the respondents gave conflicting views on the issue. About 55% of the ERO and 52% of the researchers answered the question on this issue. About 17% of the ERO and 27% of the researchers presumed that the regulation of the ownership was done on individual basis, i.e. from case to case. In addition, about 67% of the ERO and 27% of the researchers were of the view that they were regulated by the institution/institute where the patents were generated, while in the opinion of about 17% of the ERO and 46% of the researchers, the regulation was through a standard law covering all institutions/institutes in Nigeria. However, about 9% of the researchers, not hiding their ignorance, remarked they did not know how it was regulated.

The above responses show that more than 50% of the respondents were not aware of the provisions made by the government on the issues of patent ownership as contained in the Public Service Rules of the Federal Republic of Nigeria (FRN, 2008). There is therefore the need for Nigerian researchers to be conversant with government policies as it affects their work. Such policies are designed and reviewed from time to time by the government and are available public consultation.

### 4.5. Ownership of Patents Obtained from Government-Sponsored Research

The respondents also indicated their preferences for ownership of patents generated in Nigerian institutions/institutes. In all, 50% of the respondents favoured patent ownership by researchers only, while about 39% favoured ownership by the institutions/institutes. Joint ownership between researchers and their institutions/institutes of employment was suggested by over 19% of the respondents, while about 12% others favoured joint ownership between researchers and supervisory Ministries of the research institutes/National Universities Commission. In the opinion of about 4% of the respondents, joint ownership between the institutions/institutes and supervisory ministry/National Universities Commission was preferred, while another 4% preferred the initiators of the researches to own the patents. Nevertheless, the researchers stressed that patents from self-sponsored research should be owned by the researchers alone.

The preferences of the respondents to the ownership of patents notwithstanding, the provision for patent ownership, as stated in the Public Service Rules (FRN, 2008) needs to be amended to conform to current practice worldwide. The Bayl-Dole Act of 1980, which allowed academic institutions in the USA to own inventions resulting from federally-supported R&D, was earlier noted to have motivated American universities to patent their inventions. The number of patents awarded to American universities increased from 619 in 1986, six years after the bill was passed, to 3,661 in 1999 (Bremer, 2001). Conceding the ownership of patents that emanate from government-sponsored researches to Nigerian institutions/institutes and/or researchers could similarly stimulate increased generation of patents in Nigeria.

Therefore, the Federal Government of Nigeria should consider amending the current provisions on patent, as contained in the Public Service Rules, and transfer the ownership of the patents to the institutions/institutes (in trust), which should in turn jointly own them with the researchers; while the right of use of the patents should be reserved for the government, as is presently the case. The amended policy should be adequately publicised among the institutions/institutes and researchers. Furthermore, the institutions should design appropriate sharing formulae for royalties they obtain from the patents among identified stakeholders, ever before they start to generate patents, such as that of University of Newcastle upon Tyne reported by Howells *et al* (1998).

The ERO that licensed its patent to a foreign firm receives 7.5% of the net profit earned by the firm from the exploitation of the patent as royalties, and disburses the royalties as follows:

i. Two thirds of 5% to the appropriate Department of the ERO;
ii. One third of 5% to the staff of the Department; and
iii. 2.5% to the initiator of the research that led to
iv. the patent.

### 4.6. Consultation of Patent Documents for Research in Nigeria

Besides accessing for industrial exploitation, patent documents could be consulted for technological information, on which to base further R&D that may lead to the improvement of the patented technology or the development of new ones. However, the low level of consultation of patent documents in Nigeria as indicated by WIPO (1997) makes it doubtful if Nigerian educational

institutions, research institutes and researchers make use of patent documents as springboards for further research activities. The low utilisation of patent information is deplorable. The researchers should therefore be encouraged to consult patent documents especially at earlier stages of their R&D endeavours.

## 5. CONCLUSION

From the study, it can be concluded that Nigerian universities and research institutes generated some inventions, but they hardly patent them. Researchers in the institutions/institutes were ignorant of issues relating to patents, neither did they consulted patent documents. This situation may be a reflection of inadequate patent education in Nigeria. Government policies on patent matters are not well known to the researchers as well. Furthermore, government policy on patent did not encourage Nigeria researchers to patent the inventions they generate.

## 6. RECOMMENDATIONS

To encourage Nigerian researchers and institutions patent their inventions, the government should grant them ownership rights to patents that are generated from government-sponsored researches, while the institutions should design adequate sharing formulas among relevant stakeholders for the ensuing royalties from patents. It is therefore necessary to strengthen the Intellectual Property Technology Transfer Offices (IPTTOs) that have been established to function effectively in identifying patentable inventions, patenting and managing the intellectual property of their host institutions. The study was limited in scope as it covered three disciplines in a few institutions. To obtain more detailed description of patent activities in Nigeria, a comprehensive study of the universities and research institutes is suggested.

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