Bloomfield Academic Society www.bloomfieldeducation.com

ACADEMIC TECHNOLOGY TRANSFER TO INDUSTRY IN SOUTH-EASTERN NIGERIA: HOW INFORMED ARE THE PLAYERS?

Chimdiya Julian Onyeka
Leicester International College of Higher Education
132-134 London Road, Leicester, LE2 1EB, United Kingdom.

Abstract: The Nigerian government's Vision 2020 programme seeks to have Nigeria occupy a position as one of the world's 20 largest economies by the year 2020. As part of efforts to grow the Nigerian economy, the transfer of academic technologies has been identified as a possible means of diversifying Nigeria's current oil based economy. To successfully commercialise these technologies, Nigerian universities require efficient technology commercialisation models. This pilot study set out to explore the awareness rates for technology commercialisation mechanisms in south-eastern Nigerian universities in the full two year period following the signing of the Science Endowment Fund in 2006. This study also checked for the existence of the five components of the University of California San Diego (UCSD) best practice commercialisation model in any of the commercialisation mechanisms available in south-eastern Nigerian universities. The findings included an 82% awareness rate in the two years under investigation and varied levels of reflection for the five UCSD components including 20% of mechanisms reflecting at least 3 out of the 5 UCSD components. The study goes further to recommend further research into the area including perhaps a similar study in other parts of Nigeria.

Key words: Technology-transfer, Vision 2020, technology-commercialisation, Nigeria, UCSD

INTRODUCTION

Universities are increasingly facing the problem of poor research and development funding coupled with inadequate expertise required for the successful commercialization of their discoveries and inventions (Association of University Technology Managers (AUTM), 2006; Friedl, 2006; Pisano, 2006; Powers, 2006). In the absence of useful solutions to their commercialization needs, university technologies miss out on the possibilities of becoming medical devices, drugs or diagnostic tools or treatments for the life sciences. As a result, academic institutions have created intimate relationships with the industry enabling them to make a more direct entry into biotechnology business. In some cases, the involvement of some academia in activities of a commercial nature have led to unintended results, like concerns over faculty roles, conflicts of interest and questions on the overall purpose of an academic institution.

Irrespective of these consequences, non-utilization of the chances of producing biotechnology successes poses significant negative threats to not only universities, but also public interest and welfare.

This study will start by looking at the situation in the United States, the United Kingdom and will then move on to focus on Nigeria. This is done in order to set a broad idea of global trends in the subject area.

LITERATURE REVIEW

Since the early 1980s, the United States' university based businesses and technology licenses have infused over 25 billion United States dollars into the academic community with 1.38 billion United States dollars in licensing income in the 2004 fiscal year and almost 1 billion United States dollars reported for the 2003 fiscal year (AUTM, 2006). Consequently, several communities have developed an increased expectation of economic development resulting from academic research since universities have been identified as crucial in the revitalization and expansion of economies.

In the United States of America, many large states make huge investments in Bioscience research and development. For instance, the owner of Dole Foods (Mr. David H. Murdock) was reported to have partnered with seven universities in North Carolina in the establishment of a 1.5 billion dollar Biotechnology research complex in North Carolina (Fischer, 2007).

Of recent, other states in the United States have started investing significantly in the development of biotechnology with the purpose of creating solidified partnerships between industry and academia. Washington State in the United States of America created a 350 million dollars programme called the Life Sciences Discovery Fund. Governor Deval Patrick proposed to spend 1 billion United States dollars over ten years in 2007 (Fischer, 2007).

The state of California committed 3 billion US dollars to regenerative medicine; Pennsylvania pledged $500 million for the Jonas Salk Legacy Fund and the state of Florida set aside almost 600 million United States dollars and 200 million US dollars for Scripps research and the Burnham Institute respectively (Fischer, 2007;Schwartz, 2006). Other states have however recommended caution, suggesting that the creation of a biotechnology hub is a venture fraught with risks and potentially non-profit generating. With increasing numbers of leaders looking up to higher-education faculties for the revitalization of domestic economies the creation of jobs, economy experts are worried that these expectations might be too idealistic (Fischer, 2007, p. A-1).

As a result of the above, closer relationships between members of academia and their host communities have evolved. Certain arguments insist that institutions of higher learning are of more importance to a community's economic development than cuts in taxes (Fischer, 2006). Walter H. Plosila, Vice President at Battelle Memorial Institute stated that such economic development projects could become "a good way to diversify your region and your economy, but, by themselves, they are not going to replace your steel industry, or your textile industry" (Fischer, 2007).

Washburn (2005) comments on the risks of higher institutions selling themselves as central tools of economic growth, which has the potentials of creating false expectations. Powers (2006) further examines the possible effects of a scenario where these institutions are unable to deliver on the claims they make, and how this failure could jeopardize their future funding requests.

An increasing number of academia now believe that the expectations placed on them are rather out of proportion particularly in regions of economic depression. Sean Stafford of the Chicago University is of the view that universities play a vital role even though they cannot carry the responsibility of developing the economy (Fischer, 2006).

In 2002, a survey by Feldman *et al* showed that major successes are not the sole requirement for the commercialization of academic biotechnology. Only a few large commercial successes have generated large returns for some universities. Famous licences like the Cohen Boyer gene splicing technique of Stanford University and the University of California are not the rule but rather, the exceptions. However, these types of successes pressurize higher education institutions into creating partnerships with industry and business. (Angell, 2000; Edwards, Murray & Yu, 2003; Gordon, 2004; Spack, 2005; Vallance, 2001). Such successes also encourage university staff to invest more time into financially profitable research (Etzkowitz, Webster & Healey, 1998; Newman, Couturier & Scurry, 2004; and Slaughter & Leslie, 1997).

These warnings have in fact failed to reduce the habit of expecting biotechnology research to perform economic miracles. Individual corporations and universities are committing massive resources into the creation of new facilities and for the attraction of high calibre research personnel (Fischer, 2007, p. A-1). Slaughter and Leslie (1997) define this economic push as academic capitalism. Academic capitalism particularly refers to the research activities of higher education institutions, considering that some of the rarest and most valuable human capitals are found in academic institutions. In circumstances whereby this very capital benefits the university faculty member or the university itself, or even the organizations

which co-operate with them and then the social polity, it is translated to academic capitalism (Slaughter & Leslie, 1997).

National universities are typically national sources of academic capital. However, the conversion of these crude resources into technology products proves rather complicated with a low rate of success. In 2006, the annual report of the Association of University Technology Managers presents the return on investment received by universities for their technology support transfer in 2004 was a mere 15 cents on each dollar. There was also a reduction in the number of institutions which reported annual loyalties over 20 million. The year 2000 saw approximately 14 institutions falling into this category. This number was reduced to 11 by the next year (2001). Juxtaposing the data, it happens that there was an increased volume of technology transfer at the same period. Inventions grew from approximately 11,000 in the year 2000 to almost 12,000 by the next year. By 2004, it was as high as an approximate 17,000. Applications for patents also witnessed an increase of about 1000 applications from the year 2000 to the year 2001. These applications have continually increased every fiscal year since then (AUTM, 2006; Blumenstyk, 2003b).

A closer look reveals a curious relationship between the number of new licences and the number of issued patents. Irrespective of common aspirations, it has not been possible to licence 97% of patents upon issuance (Wheaton, 2006, p.1).

Feldman, *et al* (2002), report that just 12% of university technologies are set for commercialization. The report further asserts that with regards to university technology transfer, the rule of thumb is that, 10 patents and 1 commercially successful product result from every 100 disclosures (p. 108). Powers, (2003) goes on to argue that irrespective of these controversies, higher education institutions are going on with their technology transfer activities in search of income and legitimacy in a continually evolving global marketplace.

STATEMENT OF THE PROBLEM

Academic institutions have increased their commercialization activities in order to address the issue of poor research and development funding for early stage biotechnology discoveries. Needless to say, lack of funding leaves life science solutions like diagnostics, potential drugs and treatments underdeveloped. (AUTM, 2006; Friedl, 2006; Pisano, 2006; Powers, 2006). Such commercialization activities entered into by these institutions include the formation of start up companies. The unintended resultant effects of such ventures include concerns over faculty roles, questions on the fundamental mission of universities and even conflicts of interest.

Irrespective of these unwanted effects, a choice to miss out on opportunities for the production of biotechnology successes poses huge negative effects for not only the universities, but also for the public. Typically, universities encourage faculty members to go commercial on their discoveries and even set up technology transfer offices to manage these activities. However, these efforts alone are insufficient in ensuring a successful transfer of academic technologies to the marketplace (Slaughter & Rhoades, 2004). The percentage of academic discoveries which get successfully transformed to commercial products is very low (AUTM, 2006; Chukumba & Jensen, 2005; Milken, 2004; Pisano, 2006; Powers, 2006). An option of increasing the success rate of biotechnology transfer is the provision of a novel broadly applicable structure which provides a more comprehensive approach to reduce the divide between nascent discoveries and Venture Capital funds. Such structures should be able to also simultaneously address the issues earlier raised (like concerns over faculty roles, questions on the fundamental mission of universities and conflicts of interest).

The University of California at San Diego commercialization model was ranked as first in essential Biotechnology start-up company formation by the Milken report of 2004 and 2006. This standard model at the University of California at San Diego is listed as possessing the following crucial components:

1) Efficiency of organisation founded on the small size of the university and its flat hierarchy

2) A significant high distribution of research funds to faculty members

3) A significant culture of entrepreneurship

4) A very integrated curriculum in the Life Sciences programmes

5) A tailor made commercialization program for biotechnologies including

a. expertise in research and development

b. new technology development funding

c. a launch pad for the development of new companies

(Holmes, 2006; Milken, 2004; 2006).

The Situation in the United Kingdom

At the 2008 Biotechnology Industry Organization (BIO) convention, Harriet Fear of the UK Trade and Investment described the United Kingdom as the leading European country in life science investments second globally only to the United States. According to her, the UK pharmaceutical industry made a contribution of over 28.5 billion US dollars to UK exports. This is buttressed by the presence of every major global pharmaceutical player in the United Kingdom. When asked why the United Kingdom has an established history of Life Sciences achievements, the UK's strong science base was cited as reason (BIO 2008).

27,000 of the 73,000 pharmaceutical industry employees in the United Kingdom are in Research and Development. Their gross output is estimated at about 463,000 United States dollars annually. This accounts for the UK's ranking as the most mature biotechnology industry in the whole of Europe, laying claim to approximately 41% of the public biotechnology companies in the European Union. In 2006, the revenues of the UK biotechnology industry were put at 8 billion United States dollars and 2 billion US dollars in equity (BIO 2008).

However, there are still some issues with the ease of Biotechnology transfer and commercialization in the United Kingdom. In a May 2009 report to the UK government by the Industrial Biotechnology Innovation and Growth Team, the Department for Business Enterprise and Regulatory Reform (BERR) asserts that if the United Kingdom intends to maintain its competitiveness in a rapidly evolving global Biopharmaceutical environment, then there needs to be a radical change in the United Kingdom's 'business as usual' approach. The report further advocated for a more proactive approach for the United Kingdom towards the adoption of Industrial Biotechnology (BERR, 2009). This recommendation further emphasises the importance of academic Biotechnology transfer in the United Kingdom.

In five years, London's Imperial College launched over 50 companies via its technology transfer facilities, making it one of the United Kingdoms most successful in research commercialization (Searle *et al*, 2003). The college has even developed an entity called "Imperial Innovations" which is responsible for the commercialization of the institutions commercializable technologies. Searle *et al* (2003) further state that for the successful commercialization of academic research technologies in the United Kingdom, "…the following factors are key:

A culture that encourages and nurtures entrepreneurship
Strong management team and company board;
Clear business plan with realistic targets that can be met before cash runs out;
Route to market identified and costs covered;
Competition identified and assessed;
Valuable and accessible market;
Credible business and revenue model;
Technology that provides customer benefits;
Cutting-edge technology that is well protected" (Searle *et al*, 2003)

The Situation in Nigeria

The indiscriminate importation of various technologies into Africa in general, but Nigeria in particular, was common place in the 1970s. Okongwu (2006) lists the causative factors as follows:

- Efforts at industrialization having no technological link to the local environment. In other words, the inflow of technology was uncoordinated, and there was a lack of the International Code of Conduct on Transfer of Technology to developing countries.

- The terms of technology transfer contracts were unfair and featured restrictive business practices, monopoly pricing, high royalty rates, export restrictions, non-comprehensive training and poor localized research and development activities among others (Okongwu, 2006).

In response to these, Decree 70 was passed in 1979 establishing the National Office of Industrial Property and charged the office with the efficient acquisition and transfer of technology in more liberal and useful circumstances (Ada & Oma, 2009). In 1992, the name was changed to the National Office for Technology Acquisition and Promotion (NOTAP) (Okongwu, 2006). The reasons citied for the change of name were as follows:

- To adequately reflect and represent the entire functions of the organization
- To clarify the roles of the organization and differentiate it from those of the Commerce Ministry's Registry of Patents and Trademarks (Okongwu, 2006)

Current Technology Transfer Guidelines

Generally, the guidelines for the transfer of technology in Nigeria generally intend to achieve the following:

- Encourage skills acquisition by indigenous staff
- Ensuring that remuneration is fair and just (royalties currently rank at 1-5% of net sales depending on the type of service or technology)
- Discouraging tie-in clauses and export restrictions.
- The promotion of innovation in Nigeria
- The improvement of contract quality in order to ensure that such contracts get registered (Eche, 2008).

Between June 1983 and June 2006, approximately 4000 technology transfer contracts were submitted to National Office for Technology Acquisition and Promotion (NOTAP) in all industrial sectors. Out of this number, just over 2000 have been registered (Okongwu, 2006). Incidentally, none of these has been the product of a transfer of academic technology to industry. This serves to highlight the apparent non-existence, and the urgent need for technology transfer mechanisms and models for academic technology transfer in Nigeria.

RESEARCH QUESTIONS

In light of all of the available literature on the US, UK and Nigerian technology transfer scene, this pilot study therefore focused on the following questions:

1) What is the awareness rate of academic biotechnology transfer in South-eastern Nigerian institutions?

2) How do the San Diego components operate in any models in use at these institutions?

MATERIALS AND METHODOLOGY

The heads of all 42 bioscience-related departments spread across the 8 universities in SE Nigeria were surveyed and issued with one copy of the same questionnaire respectively.

The questionnaire (see appendix 1) contained 15 questions and required the respondents to input their institution name and rank, but no requirement for them to provide their names. The questions bothered on technology transfer and commercialization techniques and tried to establish the past and present history of any such techniques at the respective institutions. No single question directly probed the respondent's personal awareness of transfer and commercialization models. Their responses to the questions, however, were an indirect indication of their awareness rates. Question 9 on the questionnaire was an indirect probe into the availability of the San Diego components in the transfer/commercialization models in use at the respective institutions.

RESULTS

Awareness Rates

39 out of the 42 heads of departments were able to return their completed questionnaires. The results are presented as follows:

Not Engaged

7 departments were not involved with technology transfer/commercialization models for two consecutive years, including the current year (2009).

Engaged for Last Year Alone.

12 departments had been engaged in technology transfer/commercialization activities in the last year (2009) alone.

Engaged for last two years.

20 departments had been engaged in technology transfer/commercialization models for the both of the two years under consideration (2008 and 2009).

Presence San Diego Components

Out if the 20 departments that were actively involved with technology transfer activities,

0 contained all five San Diego components.

4 contained 3 of the five San Diego models,

0 indicated 2 components.

12 contained 1 San Diego component

4 contained none of the San Diego components.

Analysis

82% awareness rate:

31% awareness in last year alone

51% awareness in last two consecutive years.

18% non awareness rate

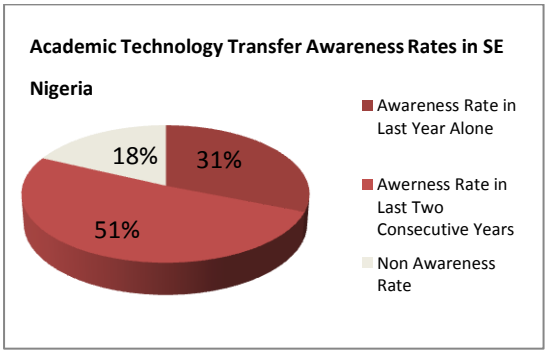

Fig 1. Academic Technology Transfer Awareness Rates in SE Nigeria

Presence of San Diego Components

Of the 51% involved in technology transfer in the last two years:

20% of the models comprised 3 of the San Diego components

60% of the models comprised 1 of the San Diego components

20% of the models comprised 0 of the San Diego components

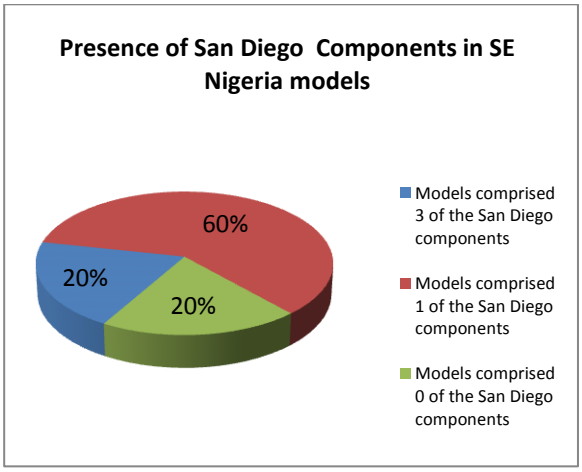

Fig 2. Presence of San Diego Components in SE Nigeria Models

CONCLUSION/DISCUSSION

From the results obtained, there is a high awareness rate (82%) of technology transfer/commercialization models among universities in south eastern Nigeria.

However, 51% of those that are aware have been actively involved in the last two consecutive years. ***Based on the principle of continuous occurrence, it follows that those bioscience departments in South Eastern Nigerian universities that have been engaged with technology transfer and commercialization for the past two years will continue to be involved with technology transfer and commercialization for the next two years, all other factors remaining constant.***

Interestingly, 20% of the active 51% comprised as many as 3 of the 5 San Diego components. ***This represents 60% of the San Diego components and by extension, implies 60% more chances of success than all other actively commercializing departments in south eastern Nigeria; all other factors being constant.***

RECOMMENDATIONS

A future study could repeat this research but with attention to the situation in other parts of Nigeria (the south western part for instance). A future attempt could also be made to look at the presence of the UK best practice model (Imperial Innovations) in any mechanisms in Nigeria.

REFERENCES

Ada J. & Oma D. (2009): 'Biotechnology and Business in Africa: Matters Arising'. Owerri: Juniasis Press

Angell, M. (2000). 'Is academic medicine for sale?' *New England Journal of Medicine*, 342, 508-510. Accessed May 27, 2009: http://content.nejm.org/cgi/content/extract/342/20/1516

Association of University Technology Managers AUTM (2006) Licensing Survey FY: 2005. Accessed March 23, 2009, from http://www.autm.net

BERR (Department for Business Enterprise and Regulatory Reform) (2009): 'Maximising UK Opportunities from Industrial Biotechnology in a Low Carbon Economy' Government Report by the Industrial Biotechnology Innovation and Growth Team. United Kingdom: BEER Publishing.

BIO (2008). 'UK Country Profile'. *BIO International Convention 2008*

Blumenstyk, G. (2003). 'Colleges report $827 million in 2001 royalties.' *The Chronicle of Higher Education*, A28.

Chukumba, C.O & Jensen, R.A. (2005, May 20). University invention, entrepreneurship, and start-ups. NBER Conference on Academic Science and Entrepreneurship: Dual Engines of Growth? South Bend, IN: University of Notre Dame, Department of Economics and Econometrics.

Eche A. (2008); 'The Politics of Business; Interests or Infringements' Aba, Enyimba Press.

Edwards, M.G., Murray, F., & Yu, R. (2003). Value creation and sharing among universities, biotechnology and pharma: An analysis of deal structures in biotechnology from the past 25 years reveals that universities often neglect important economic aspects in their licensing agreements. Nature Biotechnology, 21, 6, 618-624.

Etzkowitz & Healey, (1998). 'The dynamics of innovation: from National Systems and ''Mode 2'' to a Triple Helix of university–industry–government relations'. *Elsevier Research Policy* 29 (2000).109–123

Feldman, M., Feller, I., Bercovitz, J. & Burton, R. (2002). Equity and the technology transfer strategies of American research universities. Management Science, 48, 1, 105-121.

Fischer, K. (2006). 'The university as economic savior: As higher education replaces industry in some cities, colleges face both support and unrealistic expectations'. *The Chronicle of Higher Education*, 52, 45, A18.

Fischer, K. (2007). 'Building a new economy with biotechnology.' *The Chronicle of Higher Education*, 54, 2, A1.

Friedl, K.E. (2006). 'Overcoming the "valley of death": Mouse models to accelerate translational research.' *Diabetes Technology & Therapeutics*, 8, 3, 413-14.

Gordon, M.L. (2004, December). 'University controlled or owned technology: The state of commercialization and recommendations'. *Les Nouvelles*, 152-163.

Holmes, E. (2006). College of Integrated Life Sciences: *An Academic Model for Fostering Translational Research*. University of California, San Diego, slide presentation, May 5, 2006.

Milken Institute (2004, June). America's biotech and life science clusters: San Diego's position and economic contributions. Accessed August 12, 2009, from http://www.milken.org

Milken Institute (2006, September). Mind to market: A global analysis of university biotechnology transfer and commercialization.. Accessed July 12, 2009, from http://www.milken.org.

Newman, Couturier, & Scurry (2004). *The Future of Higher Education: Rhetoric, reality, and the risks of the market*. Jossey-Bass, San Francisco.

Okongwu D A (2006) '*Nigeria's Experiences in Technology Collaboration*' National Workshop on Developing Intellectual property Policies and Establishing Intellectual Property and Technology Transfer Offices in Tertiary and Research Institutions; Abuja; November 6-8, 2006.

Pisano (2006); 'Profiting from innovation and the intellectual property revolution' Research Policy 35 (2006) 1122–1130

Pisano, G.P. (2006, October). Can science be a business? Lessons from biotech. Harvard Business Review, 114-125.

Powers, J.B. (2003) Commercializing academic research resources: Effects on performance of university technology transfer. The Journal of Higher Education, 74, 1, 26-50.

Powers, J.B. (2006). 'Between lab bench and marketplace: The pitfalls of technology transfer.' *The Chronicle of Higher Education*, 53, 5, B18.

Schwartz, D. (2006, September). Regions bet on biotech. Urban Land, 162-165.

Searle S., Graves B., & Towler C (2003). 'Commercializing Biotechnology in the UK.' Bioentrepreneur - Online portal from *Nature Biotechnology* Accessed: 22 June, 2009: http://www.nature.com/bioent/doi/bioent710_doi.html

Slaughter, S. & Leslie, L. (1997). Academic Capitalism: Politics, Policies, and the Entrepreneurial University. The Johns Hopkins University Press, Baltimore, Maryland.

Slaughter, S. & Rhoades, G. (2004). Academic capitalism and the new economy: Markets, state, and higher education. The Johns Hopkins University Press: Baltimore and London.

Spack, E. (2005, November 7). Minding the drug development gap. Accelerator models can ease the often difficult transition between academia and industry. *The Scientist*, 36-7.

Vallance, P. (2001). Biotechnology and new companies arising from academia. The Lancet, 358, 1804-06.

Washburn, J. (2005). University Inc.: *The corporate corruption of higher education*. New York: Basic Books

Wheaton, B. (2006). Managing a medium-sized technology transfer office. AUTM Technology Transfer Practice Manual: 2007. Accessed June 12, 2009, from http://www.autm.net.

About the Author:

Dr Chimdiya Julian Onyeka is a Senior Lecturer in Strategy at the Leicester International College of Higher Education in the UK. He obtained his MSc and PhD from the University of Westminster and the University of Wales respectively. His research interests are in technology transfer and research commercialisation in emerging countries.

APPENDIX 1

Dear Sir/Madam

I am currently performing a pilot study, investigating **the existence or need for academic Bioscience and Technology transfer models in universities in South-Eastern Nigeria**.

You are invited to participate in this pilot study by completing this questionnaire and returning it at your earliest convenience to the kind individual who has passed it to you.

I thank you in advance and look forward to your participation.

Respondent's Rank/Position:

Institution Name:

Approximate Number of Students:

Approximate Number of Staff:

1. Does your school/college/faculty currently engage in any Knowledge and/or Technology Transfer activities?

- Yes (Go to question 3)
- No (Go to question 2)

2. If no, has your school/college/faculty engaged in any Knowledge and/or Technology Transfer activities over the past year?

- Yes (Go to question 3)
- No (Go to question 10)

3. How many Knowledge and/or Technology Transfer activities has your school/college/faculty engaged in over the past year (Please tick the box that applies to the number of activities

- 0 - 3
- 3 - 5
- 5 - 8
- 8 - 10
- Other

4. How many lecturers in your school/college/faculty engaged in Knowledge and/or Technology Transfer activities in the past year?

- 0 - 3
- 3 - 5
- 5 - 8
- 8 - 10
- Other

5. What type of Knowledge and/or Technology Transfer activities were undertaken by your school/college/faculty (please choose from the list below).

- Industrial / Educational collaboration leading to a new product/service or product/service enhancement
- Industrial / Educational collaboration leading to a joint bid for Government, Local Government, WHO, UN or other such funding or sponsorships
- Industrial / Educational collaboration leading to joint publication
- Educational / Industrial staff exchanges
- Other

6. Where these activities (in question 5) reported on and disseminated throughout your school/college/faculty?

Yes

No

If Yes, what medium was used to promulgate the reports (please select below):

- ☐ School/Faculty/College/Departmental Meetings
- ☐ School/Faculty/College/Departmental website
- ☐ Email/eNewsletters
- ☐ Printed Newsletter or Faculty/College Magazine
- ☐ Other

7. How did these Knowledge and/or Technology Transfer activities help your lecturers?

- ☐ Provided opportunities for staff professional development
- ☐ Enhanced curriculum design
- ☐ Supplemented the course content with real-life examples
- ☐ Improved the delivery of courses including the use of e-Learning
- ☐ Other

8. How did these Knowledge and/or Technology Transfer activities help your students?

- ☐ Gained up-to-date knowledge
- ☐ Obtained real-world industrial experience
- ☐ Developed better understanding of business issues
- ☐ Improved project work
- ☐ Other

9. In your opinion, which of the following factors have contributed to the successes (if any) achieved by the technology transfer model in use by your school/faculty/college. (Tick all that apply)

- ○ Small size of your school/faculty/college
- ○ A significant high distribution of research funds to faculty members
- ○ A significant culture of entrepreneurship
- ○ A very integrated curriculum in the Life Sciences programmes
- ○ A tailor made commercialization programme
- ○ None of the above

10. Does your school/college/faculty have a methodology for introducing students to Knowledge and / or Technology Transfer activities?

- ○ Yes
- ○ No

If Yes, what types of methodologies are employed by your Faculty/College?

- ☐ Use of Guest Lecturers from business and industry
- ☐ Inclusion of entrepreneurship, innovation and creativity sessions in the educational programmes
- ☐ Industrial Attachments/Students Industrial Work Experience Schemes
- ☐ Engaging students in industrial/business competitions and sponsorship activities
- ☐ Other

11. Do you include in your educational programmes the topic 'Entrepreneurship'?

- ○ Yes
- ○ No

If Yes, how is entrepreneurship incorporated into the educational programme? (please select choices below or describe your own):

- ☐ Getting the students to develop a prototype for a new product or a new service
- ☐ Getting the students to create a new business concept that will sell / enhance a new product or service
- ☐ New Business Start up planning sessions from business advisors and banks
- ☐ Visits to local small businesses to hear experiences from real entrepreneurs
- ☐ Other

If No, do you feel you would be able to incorporate "Entrepreneurship" into your teaching programmes if you had support materials and a good practice guide?

- ○ Yes
- ○ No

12. Does your school/faculty/college teach innovation and creativity?

- ○ Yes
- ○ No

If Yes, what methods are used to teach innovation and creativity? (please describe):

- ☐ Hands on workshops using role play
- ☐ e-Learning exercises
- ☐ Seminars involving business/industry representatives
- ☐ Problem solving exercises and games
- ☐ Project-focused industrial visits and placement
- ☐ Other

13. How are the Knowledge and/or Technology Transfer activities in your school/faculty/college funded? (please select from below):

- ☐ Government Funding
- ☐ Internal Funding
- ☐ Local Government/Regional Development Agency Funding
- ☐ Industry Funding
- ☐ Other

14. Would your school/faculty/college be interested in taking part in a programme to improve Knowledge and/or Technology Transfer activities in the Further Education sector?

- ○ Yes
- ○ No

15. You answered No on Question 1. Please could you specify the reasons as to why you do not engage in Knowledge and/or Technology Transfer activities

16. If funding was available to start a Knowledge and/or Technology Transfer activity would you be interested in engaging your school/faculty/college in this activity?

- ○ Yes
- ○ No