Technology Transfer to Industry and Society: Framework and Constraints

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Abstract - Since the 1990s, innovation has been accepted by many countries as a driver for socio-economic development. National economic success is ever more determined by a country’s effectiveness in mobilizing and utilizing knowledge. Research institutions are being viewed by various government and policy makers in many countries as engines of technological and socio-economic growth and development. This will encourage institutions and other research organizations to reconfigure themselves with structures that will maximize their capacity for economic development and revenue for the institutions. The conversion of research into economic growth is vital for the future of Nigeria and the African States. In order to improve the efficiency of this transfer, the researcher analyzed the mechanism and methods for technology transfer between the research institutions, industry and society. Also, an overview of the problems, strategies for improving the situation and technology transfer model were presented. It was recommended among other things that government should collaborate with foreign research and development institutions and develop a strong research infrastructure.

Keywords: Economic development, industries, institutions, technology transfer, technological growth.

I. INTRODUCTION

It is becoming increasingly apparent that in many countries, innovation has become a central theme of national development. The emergence of innovation-driven economy brings changes in public policy such as public sector reform, education reform and privatization. This also stimulates increased relationships and interactions among knowledge producers, transfer agents and knowledge users [1].

Universities have traditionally been thought of as the places for higher education and basic research, but serve increasingly also other than purely public interests. Over the last 30 years, we have seen a significant increase in formal technology transfer from universities and research institutes to private sector organizations in exchange for monetary compensation. It is the government’s expectation that the universities should have a third leg in entrepreneurial activities, in addition to the teaching and research activities. It is hoped that the universities actively push for the commercialization of their inventions through spin-offs, technology and patent licensing, this also named server society.1

Therefore, cooperation between universities and the industry needs to be intensified and university- inventions geared more into innovations, as it is vital that knowledge flows from universities into business and society. Stimulating collaboration between universities and the industry, technology transfer and commercialization of university- born inventions are the pertinent to achieve Vision 20:20:20. It is viewed as an enabler to:

a. Gain access to local university resources through consultancy, student projects and joint research and development projects.

b. Foster collaborations in local industries as well as global network.

c. Nurture science and engineering talents for growth of technology clusters.

d. Network industries and professional organizations for exchange and community building.

For technology- based companies, more and more skillful engineering professionals are required to expatriate foreign technology- advanced companies for technology transfer purpose. Past researches on technology transfer mainly focused on factors that influenced the results related issues, which are quite different from the problems faced by technology receivers. To improve the technology transfer performances, there is a call for the government of Nigeria and other African States to increase funding for universities technology transfer program. This paper describes a general idea of technology transfer and the mechanism for university- industry technology transfer. The document presents a technology transfer model seen from the point of view of most technology receivers so as to promote the technology transfer results and improve the economy developing quality.

II. TECHNOLOGY TRANSFER

Technology transfer is a concept that is absolutely broader than the acquisition of physical assets. The exchange of technology and know- how between firms, should contain the exchange of both resources and competence of two organizations [2]. It was stressed that the nature of knowledge that is transferable and transparent in technology transfer will become influential factors for the success of the process. The transferability of knowledge refers to the extent to which knowledge can be transferred. If the knowledge is tacit, it is more difficult to share implicit or to transfer knowledge only through coded signs and symbols. Thus, if more tacit knowledge is involved in the
technology transfer process, it is apparent that professional expatriates should try to spend more time with the technology group, to understand the norms in their organizations, or even build good relationships with the key persons in the donor firm. The transparency of knowledge is defined as the willingness or openness of a donor firm to release information and to explain difficult issues to the recipient firm. It is apparent that the more openness the donor firm, the more favourable the transfer of technology. Besides, some superior information or know-how is still conveyed through intensive interactions among people, the process may be iterative, requiring additional interpersonal contact. Thus, some social activities among expatriates and people in donor firms may also be good for fostering favourable relationships and then to facilitate successful technology transfer [3]. For the purpose of this paper, “technology transfer” refers to the process whereby invention or intellectual property from academic research is licensed.

III. UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER

The rapid rise in university technology transfer and the increased emphasis on transferring technology to the private sector for commercialization is an economic development strategy that has led to a number of empirical studies. The initial issues that confronted previous studies were how to measure technology transfer output. The studies used a variety of measures, including licenses executed, amount of royalties, amount of parents, citations analysis, patent applications, invention disclosures and a six item summary scale. The Data Envelopment Analysis (DEA) by [4] had the advantage of estimating productivity scores using multiple outputs. Two studies used survey techniques to ascertain the outputs.

The current emphasis on university technology transfer can be dated to the 1980. At this time, many of the restrictions on university licensing were removed and universities were allowed to own patents arising from federal research grants. As a result of this, the growth in the commercial application of university research had received considerable attention from public officials and university administrators. More and more research universities had set up their institutions Technology Transfer Office (TTO), although the exact name of the office varies among universities.

University administrators cited technology transfer as evidence of the increasing contribution of universities to the economy and recognize it as a potential source of university revenue, especially in the current economic environment of reduced support for universities. Among the other benefits of technology transfer to academic institutions are positive effects on curriculum and a marketing tool to attract students, faculties and additional industrial research support.

IV. CONCEPTUAL MODEL: THE UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER MODEL

It is recognized that there are several and important technology developments and each day more and more companies are creating and innovating in-house processes, products, knowledge, technologies, which might be transferred either to other companies or the other countries. Nevertheless, we feel that transferring these technologies to the market remains still an opportunity area for many innovation centers and universities. A description of technology transfer mechanism requires a system and a system requires a model of applications it is intended to support. Without a model, it is impossible to determine what variables to measure, what attributes to observe, what data to gather, what questions to ask, what relationships to explore and what scales to measurement or employ.

The model represents our interpretation of most universities’ and industries reality. At the same time, model pretends to show opportunities to create a proper technology transfer environment for innovation. There are many mechanisms for the technology transfer of research and technologies developed by local universities and research institutions. At first, this may just involve discussing areas of mutual interest or getting involved in an undergraduate research project or providing a placement for a student to get work experience. The next step may start larger scale collaborations. This normally involves a contribution from the external partner. The type of technology transfer mechanism to be used in any particular research depends on various factors. A typical technology transfer model for most industries is graphically shown in figure 1.

V. THE MECHANISM OF UNIVERSITY-INDUSTRY TRANSFER

Market requirements: As in many technology transfer models, the point of entrance is led and defined by the market. The unsatisfied needs represent a lot of opportunities for entrepreneurs and universities. In some cases, those needs could be very basic but also, in high technology markets, the needs might be complex and sophisticated as those in the industry in any developed country like Nigeria. A good understanding of the market is necessary when somebody is trying to introduce new products or technologies. It is frequent to find business cases which are not based on the reality but they are based on figures and facts in developing countries.

Imaging phase: The next step of the model is the imaging phase. It is a phase for developing solution and process. Not only market needs should be considered but also it is important to look at the political and economical environment in order to foresee the actual viability of the product.

Seeking technology: Once a solution has been created and documented, the seeking of available technologies starts. A common practice is the creation of joint ventures between university and industries. A company having an idea and a
business plan may start to look at universities trying to find available technologies that may satisfy the needs. In those ventures, the university provides the technological know-how of the core business while the partner provides the know-how on administrative tasks (accounting, human resources, taxes and so on). It is important to mention that the circle marked as available technologies could be any of the technology transfer models seen in class. We see the industry need as input for that technology models where the market is the input.

Product design: One important point to consider is product design of the technology that is frequently needed. Here we see a very important loop going back and forth until the technology is ready for the industry conditions. The chosen technology must be adapted to fulfill not only market needs, but also regulatory aspects such as technical specifications and security norms.

Implementation phase: When the technology is ready, the implementation phase starts. If the technology is a final product, i.e. if it goes to a consumer; the implementation phase may be commercialization and consequently the logistics period for importations, delivery and so on. If the technology to be deployed is part of a manufacturing process or infrastructure of a venture, the implementation phases may be exactly that, deploying the technology up to the point it is ready to produce the final products. Since the technology is either a final product or part of the production chain of a final needs being satisfied or modified. When needs are not being satisfied, a loop back to step 4 should be considered.

Life cycle management: The final step in our model is the life cycle management. Here, we mean that the product, the market, the process should be constantly evaluated. If needed, a loop back to the adaptation step may be considered, but if needs are dramatically changed or if new opportunities are detected, a loop back to start the cycle should be considered. A good opportunity to adapt existing technologies to new processes or products is there available for the implementation step.

VI. CONSTRAINTS ON UNIVERSITY- INDUSTRY TECHNOLOGY TRANSFER

As a developing nation, the need for greater university-industry collaboration and research commercialization is hampered by a number of constraints including:

i. The dominance of foreign investments in the critical sectors of manufacturing;

ii. Lack of effective research and development funding in industry;

iii. Lack of highly capable scientist who can lead in terms of knowledge frontiers;

iv. Lack of innovative entrepreneurship and

v. Focus of universities towards teaching thus creating a divergence of objectives between university and industry.

VII. ACCELERATING UNIVERSITY- INDUSTRY TECHNOLOGY TRANSFER

Various enhancements are in line with the aim to focus on key and strategic areas of research and to provide adequate funding to research that are in-line with market-driven research and development.

i. The government should as a matter of urgent importance encourage the participation of local investors in the critical sectors of manufacturing to foster university-industry technology transfer.

ii. The government of African States should increase funding to the universities for effective university-industry technology transfer that will improve research and development in the continent. The focus is to generate a smooth flow in the linear research development capital value chain, from basic research and development work to commercial trails and then to full industrial scale-up.

iii. Government should collaborate with foreign research and development institutions to develop a strong research infrastructure that will open the gates for an effective and efficient universities-industry technology transfer in Africa States.

iv. In addition, government policies should include special tax exemptions for expanding industrial support of research and development. This will create permissions for collaboration with foreign research and development supporting institutions that we lead to the development of a strong research infrastructure.

v. Form legal perspective, the situation regarding the ownership of university-inventions has been complex resulting in many arguments and ultimately difficulties in technology transfer. Since information, knowledge sharing and collaboration are the mainstays of innovation, this issue warrants a serious look by government and other stakeholders.

VIII. CONCLUSION

University research is a source of significant innovation-generating knowledge, which diffuses to adjacent firms and entrepreneurs. Universities have established technology transfer offices to foster interaction with industry and commercialization of research. Our study advances knowledge about the factors that influence the success of technology transfer and put the framework of the transfer mechanism, then, also suggests policy recommendations. Among the contributions of the study is to analyze the impact of university organizational practice and environmental factors on the success of university technology transfer.

Despite some drawbacks and constraints with respect to the industry-academia collaboration in the country, the government over the last fifteen years has been putting into place an Integrated Science and Technology Policy encompassing a number of strategies enabling such an activity to thrive in the country’s quest for technological
mastery. Under the current thrust of Science and Technology Policy towards this direction, the academic and corporate society will have to be more sensitive with respect to research collaboration.

REFERENCES


Figure 1 Framework of technology transfer