

University –Industry Partnership: Meeting the Challenges of the 21st Century

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1. Introduction

Universities play a crucial role in society as producers and transmitters of knowledge. In recent years the discussion whether academia can encompass a third mission of enterprise development, in addition to research and teaching, has received greater attention (Mansfield,1995;Branscomb et al, 1999; Etzkowitz & Leydesdorff, 2000). Much of the current debate on university-industry links focuses on a narrow range of activities such as spin-offs and start-ups from universities and higher education institutes, and the licensing of intellectual property. However, as many authors have noted, university-industry links embrace a much broader spectrum of activities than commercialization of intellectual property rights (Agrawal and Henderson, 2002; Mowery and Sampat, 2003; Cohen et al, 2002;Schartinger et al, 2001). In particular, Cohen et al (2002), using the data from the Carnegie Mellon Survey of R&D performing firms in the US, highlighted that for most industries, patents and licenses were of lower importance as channels for conveying public research to industry compared to publications, conferences, informal interactions and consulting. In addition, Schartinger et al (2001) and Roessner(1993) have shown that patenting and licensing account for a low proportion of university- industry interactions when compared to other formal arrangements such as contract research or joint research agreements.

In this paper the interface between universities and industry is studied as a way of responding to the economic needs of society in the twenty-first century through academic entrepreneurship i.e. the variety of ways in which universities take direct part in the commercialization of knowledge through the supply of creative research and inventions. This university-industry interaction will help the industry deal with financial pressure to reduce costs and increase efficiency; increased competition and rising customer expectations. It will also enhance the ability of universities to deal with global competition in the academic market place; pressure to diversify financing sources; and rising demands from students and society for quality and relevant curricula.

2. Channels of Knowledge transfer between university and industry

As suggested in the preceding section, there is abundant empirical evidence to suggest that the process of knowledge transfer between university and industry occurs through multiple channels such as personnel mobility, informal contacts, consulting relationships, joint research projects, and spin-off companies and that patenting play a comparatively small role in the process(Faulkner and Senker, 1995; Arundel & Geuna, 2004; Sequeira and Martin, 1997). This is partly because only a minority of university-industry interactions are motivated by the prospect of directly realized commercial products.

In this paper we have adopted a much wider approach, reflecting the fuller range of interactions. We group types of interactions into four categories as follows:

Educating People: Training skilled undergraduates, graduates and postdocs.

Increasing the stock of 'codified' useful knowledge: Publications; patents; prototypes.

Problem-solving: Contract research; cooperative research with industry; technology licensing; faculty consulting; providing access to specialized instrumentation and equipment; incubation services.

Providing public space: Forming and accessing networks; stimulating social interaction; influencing the direction of research processes among users and suppliers of technology and fundamental researchers; meetings and conferences; hosting standard-setting forums; establishing entrepreneurship centres; and promoting alumni networks and personnel exchanges (internships, faculty exchanges, etc) as well as joint industry-academia visiting committees and collaboration on curriculum development.

3. Factors affecting the researcher's interaction with industry

The literature on university-industry interactions suggests that a number of variables are likely to affect the decision of university researchers to interact with industrial partners. These variables may be divided into broad categories. The first group is related to the individual attributes of the university researcher such as previous experience in research collaborations with industry, academic status and age. Research quality is also considered as important, but in most studies this refers to the quality of the department to which the individual belongs rather than the individual per se.

The second group of explanatory variables relates to the characteristics of the university department of the researcher. These reflect organizational structures that favour (or constrain) the incentives to interact with industry. One variable used in previous studies is the volume of research income from contracts with industry, which has a positive impact on the probability of interacting with industry. Another variable is the total volume of research income from public sources.

The results of a large-scale survey of university researchers in the UK aimed at obtaining information about their interactions with industrial partners lead to the following conclusions (see Pablo D'Este and Pari Patel ,2005):

- (i) Those university researchers with a higher record of past interactions with industry are more likely to be involved in a greater variety of interactions at a given point in time;

- (ii) Also age, professional status and the involvement in patenting activities are extremely important individual features in influencing the decision of university researchers to interact with industry;
- (iii) The impact of departmental research has differential impact on the variety of university-industry interactions of a particular researcher according to the funding source(a positive impact for research income coming from industry and negative impact for research income coming from public funds);
- (iv) University departments rated highly in terms of research quality have no impact on the probability of university researchers to engage in a variety of interactions.

4. Contribution of university-industry Interactions to Innovative Activity

Innovation is the process and outcome of creating something new, which is also of value. Innovation involves the whole process from opportunity identification, ideation or invention to development, prototyping, production, marketing and sales, while entrepreneurship only needs to involve commercialization.

In a survey sponsored by the Cambridge-MIT Institute to study the innovative activities of companies in both the UK and the US([http://www.Cambridge-mit.org/downloads/innovation Benchmarking 1-7.pdf](http://www.Cambridge-mit.org/downloads/innovation_Benchmarking_1-7.pdf)) a sample of companies was asked to indicate which of a representative cross-section of the interactions indicated in Section2(i.e. informal contacts, recruitment at first degree or masters, publications, conferences, testing and standards, recruitment at postdoctoral level, problem-solving/consulting by university staff, joint research and development projects, internships, exclusive licensing of university held patents, innovation-related expenditure spent on university related activities, non-exclusive licensing university held patents), contributed to their innovation activity. They were also asked to indicate the importance of these interactions on a scale of 1-5, with scores of 4 and 5 being counted as 'highly important'.

The answers show that both in the US and in the UK, companies are involved with universities across the full range of activities discussed above. Informal contacts are the most prevalent but, interestingly, the 'conventional' modes of university output – such as graduates, publications and conferences – are the activities most frequently cited as contributing to innovation. Licensing and patenting are amongst the activities least frequently cited in both countries. This shows the importance of covering the full spectrum of interactions, and not focusing too narrowly on those associated with patents or intellectual property.

Analysis of the relative frequency of responses which rated the interaction as highly important, shows that in all of the categories a higher proportion of US companies rate the interaction with universities as highly important. US companies in particular place a relatively high importance on licensing, joint R&D and problem solving, recruitment at first degree, masters and post-doctoral level. They are also more likely to rate as highly important interactions involving internships than UK companies. This particular feature of university-industry interaction is also one in which the US companies showed a relatively high frequency of use. The differences between US and UK companies in the frequency with which they attach high importance to informal contacts and publications are much less marked. US companies tend to rate conferences and testing and standards as highly important somewhat more frequently than is the case in the UK.

In developing countries such as Kenya, and even in the newly industrialized countries such as Korea, industry's expectation of the university was for a long time the supply of well-educated human resources rather than the production of creative inventions from scientific research. Since firms did not expect economically valuable scientific knowledge from universities, they adopted a strategy of developing their own technology or importing cutting edge technologies from advanced countries. Although this conception may now be changing or even outdated in countries like Korea, firms still tend to see universities as ivory towers where professors want to openly publish their research and have little interest in the needs of industry(Lee,2002).

5. Universities as a Source of Knowledge for Innovation

The companies in the sample mentioned above, that had carried out an innovation in the previous three years, were asked to indicate the sources from which they obtained the knowledge necessary for innovation. The sources cited include competitors in same line of business; internal knowledge within the company; clients or customers; fairs, exhibitions; internal knowledge within the company; health and safety standards and regulations; technical standards or standard setting bodies; suppliers of equipment, materials, components or software; environmental standards and regulations; trade associations; professional conferences, meetings; university/higher education institutes; consultants; commercial laboratories or R&D enterprises; private research institutes; government research organizations. We also asked them, using the same scale as before, about the importance they attached to those sources. This analysis is useful because it helps keep in perspective the role of universities as sources of knowledge for innovation in the context of the innovation system as a whole.

The analysis shows that in both countries, universities are ranked far down the table in terms of frequency of use. In both countries, the knowledge sources are dominated by industrial sources (customers, suppliers, competitors, and the internal pool of knowledge of the firm itself).

6. Partnerships and Collaboration

The analysis in this section deals with the role of universities in partnership and collaborative arrangements with companies. Once again we locate these arrangements within the broader pattern of such collaborative activities undertaken by the sample companies. The types of partners considered are firms in same line of business, customers, suppliers, other enterprises within the parent group, universities, private research institutes and technology organizations/consultants, early-stage technology-based companies, public sector research and technology organizations/labs, and other higher education institutes.

The results show, in keeping with our findings of the frequency of use of universities as sources of knowledge, that a significantly higher proportion of the UK sample collaborate with universities. US companies on the other hand are more likely to collaborate with early-stage technology-based companies, and with private research

institutes and consultants. As with knowledge sources, our results reveal that other companies, competitors, suppliers and customers are the most frequent collaborators for the sample firms. Thus about half of the sample companies in each country collaborate with customers and with suppliers.

In most developed countries new conditions of innovation are such that small start-up entrepreneurs increasingly depend on large firms: as suppliers or customers; for venture finance; for exit opportunities; for knowledge(production, markets and R&D); and for opening new markets. Large firms increasingly depend on small start-ups for new product development; as suppliers of new knowledge(which they cannot develop themselves); or organizational renewal, for experimentation with business models; for opening new markets, etc.

In countries such as Korea, collaboration between the university and industry in research and development has been weak. One recent survey of Korean firms reported that 50% of all responding firms have never had research collaboration with a university(Lee,2002). In cases in which there have been relationships, the most common are simple monetary contribution from corporation to university or informal collaboration like consulting services(Woo,2002). Thus interaction between industry and university have largely been informal. At present, firms believe that inventive activities should be performed in-house. They believe that universities are not conducting research that might lead to marketable inventions.

A recent survey of Kenyan universities indicate that the proportion of R&D which is sponsored either by the industry or jointly with industry is insignificant(Gichaga, et al.,2005).

7. Obstacles to industrializing knowledge

It is widely argued that a key factor in stimulating innovation is the threat posed by competitive rivalry. Other drivers for innovation are: financial pressures to reduce costs, increase efficiency, do more with less; shorter product life cycles; value migration; stricter regulation; industry and community needs for sustainable development; increased demand for accountability; demographic, social and market changes; rising customer expectations regarding service and quality; changing

economy; greater availability of potentially useful technologies coupled with a need to exceed the competition in these technologies.

The Cambridge-MIT study mentioned above reveals that the following factors as potential barriers to innovative activity: Lack of appropriate sources of finance; innovation costs being too high; the pay-off period of innovation too long; legislation, regulations, standards, taxation; shortage of skilled personnel; innovation costs hard to control; lack of customer responsiveness to innovation; the innovation potential of the company too small; the ease with which innovation might be copied; lack of information on technologies; and lack of technological opportunities.

8. Academic entrepreneurship and the entrepreneurial university

The entrepreneurial university includes as part of its mission the third dimension of enterprise or economic development in addition to the traditional roles of teaching and research. In its organizational model the entrepreneurial university is seen as a "trading" institution which engages in a wide variety of exchanges with the state, private enterprises, and other funding agencies, with its students, with employers of its graduates and users of its research, and wider still, with society, culture and the economy.

In terms of its management and governance, therefore, the university moves beyond self-organisation. Instead it forms links with the external environment- identifying new partners and markets, developing trading relations and competing in the academic market place. The entrepreneurial university cultivates a two-way interactive relationship with the external environment with respect to curriculum development, teaching, research and innovative activities.

The entrepreneurial university places greater emphasis on commercializing scientific discoveries, and on solid and well-designed portfolios of research projects. Thus it is an active driver of innovation and academic entrepreneurship which lead in a rather natural way to partnerships with industry. Thus the entrepreneurial university not only provides educated elites for the industry but also supplies creative research and inventions. Several elite institutions have demonstrated their capacity for entrepreneurship (Clark,B.,1998).

The growth of academic entrepreneurship will depend to a large extent on the existence of the right incentive structure within the university system itself. This structure is of course highly multidimensional. A number of factors are likely to be crucial:

(i) the degree to which up to date research results and methods are communicated to students as part of the regular instruction and whether the internal reward systems, be they monetary or non-monetary, encourage excellence in both teaching and research;

(ii) to what extent and how quickly curricula are adjusted to changing demand;

(iii) the efficiency with which research budgets can be reallocated across disciplines in response to changes in commercial potential; and

(iv) the incentives in a broad sense for faculty to interact with industry in economically beneficial ways.

These factors have been dealt with more fully by Henrekson and Rosenberg(2000).

9. Academia-Industry linkages at Strathmore University

Strathmore University recognises research and innovation as a central element in its institutional mandate and pursues an institutional mission that is characterised by enquiry and continuous quest for new knowledge for innovation. It has been eminently successful in forging collaborations and partnerships with industry.

Some of the ways in which the University promotes and cultivates relationships with industry include: appointment of outstanding professionals and industry leaders to the University Council, the governing board of the University; appointment of CEOs of corporations and other industry leaders to the Advisory Boards of academic schools and faculties; continuing professional development courses for company executives; interaction through case development by university faculty; joint conferences organized by the University and private firms and corporations; appointment of senior executives from industry as part-time lecturers in the University; industrial internship for students; student projects involving real industry problems; inviting senior executives from industry to participate in curriculum development exercises initiated by the University; sponsorship of students by private firms through scholarships and bursaries; awards and prizes provided by private firms and corporations; alumni networks; consultancy services to the industry by

university faculty; training partnerships with various firms, corporations, professional associations, etc.

10. Conclusions

In Kenya today localized knowledge spillovers are almost non-existent. There is negligible evidence that Kenyan universities are contributing significantly to technological innovation in Kenyan industries. The university system in Kenya from the outset started as training institutions rather than knowledge generators. Their main role was to provide educated elites to the industry. The university's interaction with industry was through supply of trained manpower.

Knowledge which is available in our universities can be used by industry to improve the methods of production and quality of the products and services. While universities continue to conduct basic applied research, university-industry interaction will enable universities to undertake research relevant to industry. This will in turn improve the quality of education offered in the universities. To promote the transfer of this knowledge from the university to industry, the university should make information available through conferences, publications, industrial internships, employment of graduates, student projects involving real industry problems.

To promote university-industry interaction and enhance academic entrepreneurship, the right incentive structure is required. If the incentive structure within the university is aligned to encourage active cooperation with private firms, then cooperation will be increased. For example universities may include industry interaction as a criterion for professorial evaluation. Provide financial return to those who pursue industrial research. Link remuneration with the individual professor's research and teaching performances and to vary the level of remuneration according to the economic value of specialization.

Another important factor likely to determine the contribution of academia to economic performance is the relative payoff to becoming an entrepreneur rather than becoming and/or remaining a salaried employee, notably the relative payoff for highly qualified professors in our universities.

Formal contract research between the university and industry has been limited. Instead, informal interactions have existed and they provide an important conduit for transfer of knowledge from university to industry. A good example is faculty consulting, based on personal interactions. Some firms cultivate personal ties with professors more as recruiting instruments than as a source of new technology.

To promote entrepreneurship based on university research, universities in Kenya should create organizations to manage technology transfer. An example of such an organization is the Strathmore Research and Consultancy Centre, which is a private company affiliated to Strathmore University whose role is to manage contract research, consultancies and commercialization of knowledge and inventions on behalf of the university.

There is also need for a legal infrastructure to facilitate the exploitation of the university's inventions and patents.

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