Editorial: Moving beyond metaphors: University-industry collaboration in biotechnology

A PERCEIVED GAP

There is enormous public interest in the role of universities as a primary source of new knowledge, new skills and new ideas for addressing many issues facing industrialised societies. In recognition of this, programmes to promote university–industry collaboration have expanded rapidly in recent years. Nevertheless, despite an abundance of such programmes and resources to facilitate the translation of technology from universities to industry, there often appear to be very significant disparities between the needs and requirements of industry and the university. A couple of recent quotes serve to illustrate this point:

> UK university–business collaboration has been unsuccessful for too long. The UK has an exceptionally strong science and technology base, founded primarily in our university research capability. Yet business and academia consistently fail to translate this resource into profitable world-leading technologies and products made by companies with sustainable futures. Both sides are equally to blame.
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> Business continues to limit its investment in university-led – and, in effect, state-subsidised – research and development. In the UK, business spends only 2 per cent of its available budget on university research. Academia, on the other hand, consistently refuses to acknowledge the link between research and profit.[1]

> Within universities, a mismatch exists between academic and commercial cultures. Universities by their very nature reward academics for their research and teaching efforts and do not generally encourage or reward entrepreneurship.[2]

In a similar vein, Lord Broers, the former Vice-Chancellor of Cambridge University from 1996 to 2003, lamented the results of a recent joint international review of universities which concluded that, while some researchers in UK universities were aware of the impact their work might have beyond university boundaries, many more researchers 'were not well informed or motivated to produce external impact'. Broers stated that the UK must address these shortcomings if it is to maintain a university base that can supply business-led innovation to industry.[3]

Why is there this mismatch between the university and industry, and how might it be bridged? The disparity seems to be the result of unfulfilled expectations, and is often because universities have not identified or rationalised what it is they want to do and are able to accomplish. Also, perhaps part of the reason lies in the unrealistic metaphors conventionally used to depict the role of the university.

CONVENTIONAL METAPHORS

In recent years it has become customary to hear the university discussed as a 'knowledge factory' or as an 'engine' of regional and national economic development. These metaphors have captured the attention of business leaders, policy makers and academics who have looked at the examples of technology-based regions of excellence like Silicon Valley in

California and the Route 128 region surrounding Boston/Cambridge in the USA. They have concluded that the university has played a fundamental role in developing the innovations and technologies that power those regional economic models. Consequently, a theory of sorts has been promulgated based largely on anecdotal evidence or specific success stories of the university as a powerhouse of regional economic development.

This view is in many respects similar to that of the now discredited 'linear model of innovation' which rests on the assumption that there is a linear pathway from university science and technology research to commercial innovation and on to regional development in the form of ever-expanding networks and genealogies of newly formed firms. This model is in turn reflected in a wide variety of university-based and publicly supported 'technology transfer' programmes that aim to increase the output of university 'products' that are deemed of value to industry.

These conventional metaphors may be misleading because they fail to reflect the changed dynamics of knowledge production and the society for which it is produced. The university's economic role is much more complicated, subtle, nuanced and complex than such mechanistic thinking suggests. Instead of perceiving the university as an engine of economic development, it is perhaps more appropriate to conceptualise it as a component of an underlying infrastructure for innovation upon which the system of knowledge-based capital draws.

BIOTECHNOLOGY METAPHORS

In the biotechnology industry, too, metaphors are invoked. The academic literature invariably mentions the contributions of three actors: the universities or other scientific institutions that are the sources of knowledge in basic science; the start-up research-intensive biotechnology firms; and the large and established pharmaceutical companies. These three agents have been described as commanding complementary resources for the generation, development and commercialisation of innovations in biotechnology. The interaction between these actors has been depicted as the 'locus of innovation' in biotechnology. Other accounts portray the relationship between government, universities and companies in biotechnology as a 'triple-helix'.

While metaphors serve a purpose in science, these accounts may be too simplistic in biotechnology for several reasons. First, biotechnology is displaying a veritable collapse in the cognitive, experimental and temporal gap between basic and applied science, so that the simple dichotomy between basic and applied science and their associated institutions is becoming less meaningful. Secondly, such descriptions draw an unrealistically sharp distinction between the public sector and the private sector. Institutional structures and divisions (eg between industry, government and university) are breaking down as large, interdisciplinary, multisourced and multifunded research groups explore strategic science issues, as witnessed by the Human Genome Project and current international programmes in stem cell research and bio-nanotechnology. Thirdly, they do not bring out the degree of overlap among the activities of the constituent agents. For example, universities may conduct applied research, while the new entrants and the large pharmaceutical companies often have substantial in-house basic research programmes. Fourthly, they do not capture all of the agents involved in an innovation system, particularly in countries other than the USA and the UK. Instead, they depict a somewhat closed system with no account of interactions with other institutions and industries. Finally, they fail to capture the flows of knowledge, competencies and other transactions between the various agents in an innovation system, and the extent of these linkages.

UNIVERSITY–INDUSTRY LINKAGES

Given these institutional changes, to what extent does industry cultivate and forge ties to universities? Surprisingly perhaps, it seems that much of the impetus for closer

university–industry links is driven not by firms but by universities. According to research conducted in the USA, the prime movers in the drive to develop closer academic–industrial ties are universities rather than industry. In many respects, this has been prompted and conditioned by shifts in government science and technology policy. Arguably, the same may also be said of the UK, where increasing constraints on public funding for research, together with demands on universities to demonstrate the relevance to industry and society of their research, is providing impetus for universities to act commercially and develop closer academic–industrial ties. Government policy and initiatives have encouraged this trend by creating the impression that allocation of funding requires demonstrable links to industry, thus promoting more universities to jump on the commercialisation bandwagon.

Meanwhile, industry's views of growing university–industry research ties appear decidedly mixed. While cutting-edge academic research is highly valued, industry is concerned that too much focus on commercialisation will impact negatively on the education and research functions of the university, that the results of research are often not directly relevant to the interests of participating companies, and that there is often unnecessary bureaucracy and wrangling over intellectual property rights.

In addition, it appears that, although the university is a necessary component, it is insufficient by itself for regional technological and economic development. What appears to matter – and what is often neglected in policy circles – is 'regional absorptive capacity', or the ability of firms in a region to absorb the science, innovation and technologies that universities generate. In other words, firms and regions need to be able to capture the scientific and technological 'spillovers' of universities.[4] Research suggests that even if the ability to generate new ideas and new knowledge exists in many places, it is those locations having the ability to absorb and use those ideas, such as the California Bay Area and the Boston/Cambridge region, that are able to turn them into sustainable economic wealth.

Ultimately, the ability to capture knowledge spillovers relies on the most critical contribution of the university to economic development: talent, the key resource of the knowledge economy. As a factor of production, talent has a number of characteristics: it is highly mobile; its distribution in scientific and technical fields is highly skewed; and it attracts other talent. Effective university-industry collaboration is very much a people-oriented endeavour. The term 'technology transfer' is an oxymoron: technology as an abstraction cannot move – rather it is people and their knowledge that are transferred. This requires recurrent relationships which are nurtured over time in several stages, which may be labelled as the 'four A's' of knowledge transfer: *Awareness* (recognising one's own technological weaknesses, and sources of knowledge and technological capability elsewhere), *Association* (forging a relationship with external sources of knowledge), *Assimilation* (the ability to absorb new inputs of knowledge and technology) and *Application* (building sustainable technological capability that is applied to new products or processes).[5]

ABOUT THIS ISSUE

For this issue, we were fortunate to attract an eclectic and international range of contributors, all of who have experience of, or are concerned with, university–industry interactions. The first paper is by Christopher Lowe, the founding and present director of the Institute of Biotechnology at the University of Cambridge. The institute was established in 1988, and its reputation has grown under Lowe's energetic leadership. It not only educates and trains talented scientists, but it also undertakes leading edge research in a broad range of biosciences, acts as a major interface to the regional biotechnology community, generates spin-out firms that exploit technologies developed in the institute, and helps to formulate national policy for biotechnology. Lowe's paper portrays an entrepreneurial institute and discusses its spinout activities.

The second paper, by Kirsten Leute of the Office of Technology Licensing (OTL) at Stanford University, examines Stanford's licensing and equity practices with biotechnology firms. This paper provides valuable insight about how the OTL works with Stanford's biotechnology start-up firms to negotiate licensing agreements, and also examines the rate of success of such firms based on equity data. In the next paper, Paul Goldsmith and Derek Jones of DanioLabs, a University of Cambridge biotechnology spin-out firm, reflect on the firm's collaborative links with the Cambridge Institute of Medical Research and how these have evolved over time. The following paper, by Lita Nelsen of the Technology Licensing Office at the Massachusetts Institute of Technology, considers the pivotal role played by MIT in the emergence of the biotechnology cluster in Massachusetts. The papers by Leute and Nelsen illustrate how Stanford and MIT are the premier examples of successful university–industry collaboration and academic entrepreneurship to which all other universities aspire.

Returning to the UK for the next paper, the often-overlooked concept of 'value' in university commercialisation is addressed by Alison Campbell of King's College London Enterprises (KCLE), the wholly owned commercial management company of King's College London. King's College London is in the top five English universities for research earnings, and KCLE manages all aspects of the College's external partnering activities from business development through to technology transfer, consultancy and start-up company formation. Campbell's paper reminds us that short-term financial measures are insufficient by themselves if universities are to assess their commercialisation activities strategically.

The subsequent paper is by Benjamin Adler, an intellectual property lawyer with Adler & Associates in the USA. This addresses several topics in US biotechnology patent law, and in particular how these affect the ability of universities and research institutions to secure legal protection for biotechnological inventions. Finally, a thought-provoking paper by William Bains of Rufus Scientific analyses how academics might best make money from their knowledge and expertise, and considers options such as licensing intellectual property and consulting.

This issue is completed with an additional paper by Scott Familant, a partner in the New York office of Orrick, Herrington & Sutcliffe LLP, one of America's pre-eminent intellectual property law firms, on a recent ruling that may challenge the importation into the USA of biological products manufactured abroad using processes patented in the USA.

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