SPECIAL ISSUE

Knowledge circulation

Introduction

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'Knowledge society', 'knowledge workers', 'knowledge companies', 'knowledge production' – all these are phrases that we regularly encounter in any line of business. Any phrase that includes the word 'knowledge' is 'in'. Here, we introduce yet another alternative: knowledge circulation. But what are we adding that is new?

'Knowledge circulation' describes the circulation of knowledge between organizations. It resembles 'knowledge transfer', but 'knowledge transfer' describes a linear process: the transfer of knowledge from one organization to another. No two-way flow of knowledge is implied; the knowledge does not 'circulate'. Knowledge *should* circulate, especially from the point of view of higher education institutions (HEIs). When knowledge is transferred from one organization to another, the transferring organization receives a payment in exchange: the knowledge transfer is thus a transaction in which information is bought and sold. HEIs are, of course, interested in 'selling' their knowledge to interested parties, but they are equally interested in having something more in return than simply money. They also want to *learn* from the transfer of knowledge and to acquire new knowledge. This is becoming more and more important because the roles that organizations play in the innovation process or, more appropriately, the innovation arena, have changed. In today's knowledge society the boundaries between knowledge (and the different types of research that produce knowledge) and its development into products and services are rather fluid. This does not imply that the actors (knowledge producers, application builders, product developers) and their roles in the initial phases are the same as in later phases, but simply that the transitions between the phases are fluid and that the 'baton' in the transition phase is sometimes passed to another actor in the process. In the first phase of the production of knowledge the emphasis is on knowledge 'creation', while in the later phases the emphasis is on configuring and reconfiguring the knowledge into new combinations to solve a problem in the context of application. There are many ways to conceptualize the process from the creation to the application of knowledge. Van Vliet (2003) proposes a cyclical process: knowledge development (or production) → knowledge sharing → knowledge utilization (application) → knowledge evaluation → knowledge development.

Different types of knowledge production

Stokes (1997) maps research on two dimensions. The first dimension is the quest for fundamental understanding, and the second is the consideration of

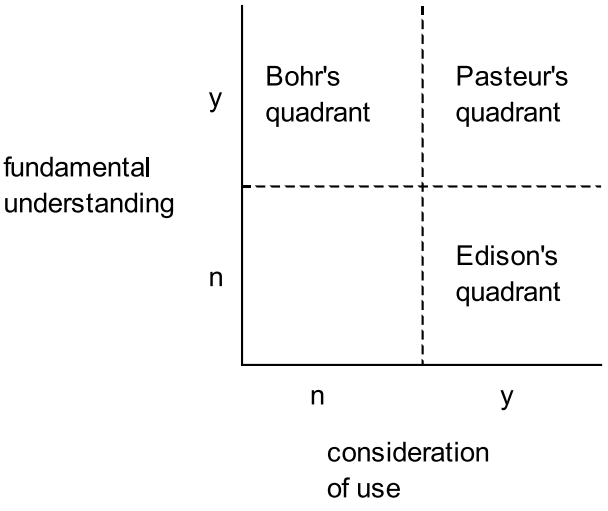

Figure 1. The quadrant model of scientific research. *Source:* Stokes, 1997.

use. The two dimensions combined give what Stokes calls a 'quadrant' model of scientific research (see Figure 1).

The top left-hand quadrant is named after Niels Bohr, the scientist who explored the atom model, which at the time had no practical use. The lower right-hand quadrant is named after Edison, the inventor behind electric light; his goal was to come up with a commercially profitable solution. The top right-hand quadrant is named after Pasteur, who combined both approaches – a fundamental understanding of the phenomena with a major societal impact. The fourth quadrant, which has no name, could be called 'curiosity': research that has been designed neither in pursuit of fundamental understanding nor with any practical application in view (Stokes offers the example of Peterson's *Guide to the Birds of North America*). All four types of research exist and can, at some stage, cross into the next quadrant. For example, Bohr's atomic theory at the time was driven only by a quest for fundamental understanding, but in due course it was put to use to solve practical problems. This crossing of cells could be characterized by the comment attributed to Kurt Lewin that there is 'nothing so practical as a good theory'. Edison's inventions were also, in due course, located in and explained by scientific theories. Nevertheless, the ideal situation is the fundamental understanding of a practical issue that leads to a solution rooted in a (new) scientific theory. In today's knowledge society, there is definitely a preference for the type of research represented by Pasteur's quadrant – or, to put it another way, for research that takes into consideration the practical potential of the findings or, even better, research that is initiated to contribute to the solution of a problem (as distinct from straightforward problem-solving and trouble-shooting). Knowledge production by HEIs can and should have these characteristics.

Gibbons *et al* (1994) distinguished between two different modes of knowledge production, labelling them 'mode 1' and 'mode 2'. Although there are many distinguishing parameters between the two modes, for the purposes of this introduction one distinction is particularly important: in mode 2, knowledge is produced in the context of application. The first impulse is to locate this in Pasteur's quadrant, but this is to underestimate it. Mode 2 knowledge is partly what Stokes had in mind when he referred to a combination of use and fundamental understanding, but it is also knowledge that is produced via new combinations of existing knowledge (models, data, theories, etc). Gibbons *et al* refer to the researchers involved in this process as 'symbolic analysts'; Sheen (1999) prefers the term 'symbolic integrators', inferring that such researchers configure and/or reconfigure knowledge and that the process they are involved in is one of 'knowledge circulation'.

Actors in knowledge circulation

HEIs no longer operate in isolation from other societal institutions and they have an increasing impact on regional innovation. This development has been highlighted by various authors. Davies (1987) was among the first to address the issue in his report on an American study tour. Among the factors that characterize the 'entrepreneurial and adaptive university' is its relationship with industry. Clark (1997) discusses the 'entrepreneurial university' and indicates that the 'developmental periphery' (the mechanism which enables the institution to interact with the outside world) is a key element in the operation of such institutions. Etzkowitz and Leydesdorff (2000) use the concept of the 'triple helix' to describe the interaction of HEIs, industry and government. Goddard (1997) introduces a regional variant of this idea, identifying as a critical function the management of the interface between the HEI and the region (industry and regional government) – see also Ten Pas *et al*, 2002).

All these authors illustrate the important and, especially, the changing role of HEIs in the innovation system. In a recent publication, Tornatzky, Waugaman and Gray (2002) combine most of the above ideas into a new model, 'Innovation U.', in which the three important actors (HEIs, government, industry) together

produce locally 'captured technological outcomes' that result in economic development. The output of the 'triple helix' type cooperation, with an added value ('knowledge circulation') for all the organizations involved is:

- new knowledge – knowledge derived from various sources that is created via new combinations and configurations and evaluation and cooperation;
- state-of-the-art knowledge;
- smart people or improved 'human capital';
- technology; and
- entrepreneurship.

The impact becomes visible in the economic development of a region (or city) via these outputs of 'triple helix' cooperation. New companies, especially knowledge-intensive and high-tech companies, are created ('entrepreneurship' combined with 'smart people'); 'technology' and 'new knowledge' contribute to the regional or local innovation system. Knowledge circulation requires the involvement of each of the 'triple helix' partners in the generation of innovation, new companies and new jobs.

Knowledge circulation

Knowledge is produced by a variety of actors, not always and not necessarily via 'invention' – more often, in fact, via a configuration of previously unconnected knowledge. The context of application requires the integration of knowledge from different sources: HEIs, government and industry (especially small and medium-sized enterprises) all need to play their role in the process of knowledge production and all need to contribute (and share) knowledge within the limits of their abilities and capabilities.

In the context of the Dutch universities of professional education, the recently appointed *lectors* (associate professors) play a crucial role in this process because one of their key tasks is to carry out research (or 'produce knowledge') with companies and institutes in their region in order to contribute to local innovation capacity and also to use the acquired knowledge to contribute to the professionalization of their teaching staff and to improve their curricula. In the wider European context, ProTon Europe (www.proton-europe.org) is an important initiative of the European Union which aims to increase the professionalism of technology transfer officers and technology transfer organizations – a measure necessary for the improvement of cooperation between HEIs and industry in a system of 'open innovation' (Chesbrough, 2004).

About this special issue

In August 2003 the World Association on Cooperative Learning (WACE) organized its 13th biannual conference in Rotterdam, with the theme 'Towards a Knowledge Society: Integrating Learning and Work'. This theme was chosen because 'knowledge-intensive entrepreneurship and innovation in the private sector will provide the global basis for economic growth. At the same time, the public sector, such as education, healthcare and the judiciary, will have constantly to adjust their method of work to meet society's changing demands.' (Leijnse, 2003.) One of the conference workshops focused on the 'New Production of Knowledge', taking its title from the seminal work of Gibbons *et al* which introduced a new mode of knowledge production. Peter Scott, a co-author of that work, is a contributor to this special issue of *Industry and Higher Education*. Scott addresses two key issues: the knowledge society and the modes of knowledge production. In the last paragraph of his contribution he writes: 'The most important reason, therefore, for the more intense engagement between universities and industry, between learning and work, is the emergence of a knowledge society and the accompanying changes in knowledge production.' This is precisely the reason behind the introduction of the concept of 'knowledge circulation'.

Gochermann and Bense approach the theme from another angle. Basing their discussion on research in Germany into science marketing, they give a simple mathematical reason why HEIs and companies (or clusters of companies) should cooperate: the total is greater than the sum of the parts.

Van Vliet and Horvath treat knowledge circulation from two perspectives: first, from the knowledge management point of view, and second from the perspective of practical application (they cite the case of a Dutch cluster on hydraulics that includes a university of professional education).

Laine, writing about the situation in Finland, focuses on the regional impact that polytechnics can and should have by increasing their interaction with local companies.

Finally, Taylor addresses knowledge circulation in South Africa, focusing on the role of the technikons (the South African equivalent of polytechnics or universities of professional education). She locates 'cooperative learning' in the context of knowledge circulation and the 'triple helix'.

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