Universities and industry – driving knowledge transfer

by Anthea van Zyl

Universities and private industry need each other, but the mechanisms that facilitate the flow of knowledge between these groups are complex and varied.

A wide gap exists in the expectations and perceptions of industry partners and universities in both directions, probably as a result of a poor understanding of the drivers of knowledge transfer in their research and development collaborations. To address this, the University of Pretoria's Department of Engineering and Technology Management initiated a research marketing and technology commercialisation survey. The survey was conducted in 2005/6.

One of the issues the survey addressed was the drivers of knowledge transfer between universities and industry firms, where industry firms are seen as buyers of research.

The interface between higher education institutions and industry

The triple helix of university, industry, and government, explain Leydesdorff & Etzkowitz (2001:1,9), provides input and sustenance to science-based innovation processes, and this network system of interactive spirals engages to promote economic development and academic research.

Etzkowitz & Leydesdorff (2000:109) write that university research may function increasingly as a locus in the laboratory of such knowledge-intensive network transition as is seen between academia, industry and government in the triple helix model components of a National System of Innovation.

According to Levin et al. (1987:783), what drives firms to collaborate with universities? "To have the incentive to undertake research and development, a firm must be able to appropriate returns sufficient to make the investment worthwhile."

Comments by respondents to a Human Sciences Research Council (HSRC) survey (2003:121-122) indicate that the following factors need to be considered:

- Industry needs access to data that will indicate what expertise is available at higher education institutions.
- Industry has a desire to share published information on technological innovations.
- Industry requires increased funding of projects to facilitate increased collaboration and it wants greater flexibility in the administration of these funds.
- Industry wants higher education institutions to focus more on product development.
- Industry needs help in matching specific industry requirements with corresponding expertise at higher education institutions.

Other requirements for collaborations in the opinion of industry firms, writes Feller (1990:337-8), are the following:

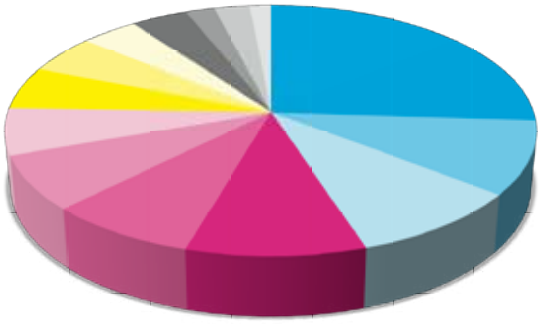
- Scientific advances must have industry-creating potential.
- There must be a dominant role for academic scientists as a source of this new knowledge.
- A venture capital market willing to invest in the long-term economical potential of basic research must exist.

Industry respondents surveyed by the HSRC (2003:66) were asked to indicate the reasons why their enterprise desired to engage in partnerships with higher education institutions. Their responses are displayed in Figure 1.

The top two priorities relate to the issues of accessing technologies and research expertise, which was not available in the firm, but was available at higher education institutions. Financial gain ranks after ensuring equity in the enterprise's workforce. Interestingly, 90% of the industry respondents commented that direct outputs were anticipated from collaboration with higher education institutions. Figure 2 highlights the anticipated results.

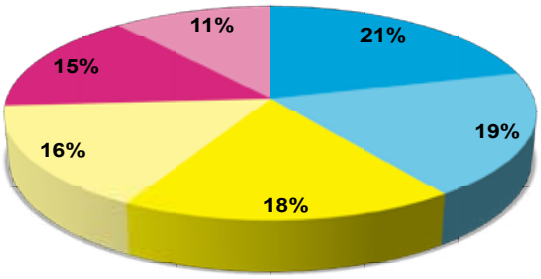
The model of the university centre as a vehicle for technology transfer has become organisationally and institutionally more complex, acting as a conduit through which knowledge exchange and exploitation is made

→ *1. Reasons why industry collaborates with Higher Education Institutions (HEIs) (HSRC, 2003:68)*



- Access to technologies and infrastructures available in HEIs
- Gain added technological value to the firm with potential of future gain
- Contribute to equity in workforce
- Access to increased R&D capacity
- Maintain competitive edge of the firm
- Gain technological value that will better processes and manufacturing
- Contribute to sustained innovation in sector
- Keep abreast of developing technologies
- Access to highly trained human resources
- Contribute toward social development in South Africa
- Outsourcing costs less than in-house research
- Added knowledge leads to improved understanding
- Contributes to the marketing of the firm
- Gain tax rebates

→ *2. What industry anticipates from university collaborations (HSRC, 2003:116)*



- New technological innovations and products
- Improved human resource capacity within the enterprise
- Improved human resources capacity within Higher Education Institutions
- The output of commercially exploitable knowledge
- The production of increased public knowledge
- Increasing the stock of scientific knowledge

more effective. Importantly, industry provides a new window of opportunity for research and support, according to Lee (1996:849).

Research design and methodology

The research marketing and technology commercialisation survey was intended to gather responses from companies in South Africa. The survey was wide-ranging and designed to address various factors, among them the drivers of knowledge transfer between universities and their industrial partners in research and development collaborations.

Companies that have current research and development collaborations with universities, or have had such collaborations in the past, were selected to participate in the survey. The survey employs the ubiquitous Likert Scale (2002:40). Respondents were asked to rate the drivers of knowledge transfer using a rating of significance from 1 to 5, with one being not significant, 2 being vaguely significant, 3 being significant, 4 being very significant and 5 being extremely significant.

It is important to note that this sample is a convenience or judgemental, non-random sample of companies in South Africa. In total, 211 industry firms received the survey and were requested to participate. Of the identified firms who were selected, responses were received from 74 firms, which included the following industry sectors: agriculture, forestry and fishing (15), mining and minerals processing (10), finance, insurance and real estate (3), the retail trade (1), construction (2), resources (0), manufacturing (19), transport and public utilities (3), public administration (2), wholesale trade (0) and services (19).

The nine drivers of knowledge transfer extracted from Cummings & Teng (2003:54) and incorporated in the South African survey were as follows:

1. The perception of knowledge as a valuable resource
2. Emphasis on return-on-investment in research
3. The need to close the knowledge gap
4. The need to extract appropriate knowledge at the right time to make critical decisions
5. The impact of international trade
6. Intellectual property protection
7. The impact of war, terrorism and natural disasters
8. The role of geographic proximity between the knowledge source and recipient
9. The need to protect knowledge for competitive advantage.

How industry partners rated these drivers individually and in terms of significance

Perception of knowledge as a valuable resource: An overwhelming number of respondents (48%) rate this driver of knowledge transfer as extremely significant, while a further 31% rate it as very significant. This finding is in line with statements made by Blumentritt & Johnston (1999:287), who acknowledge that "knowledge is a key intangible asset, but an isolated piece of knowledge, statement or theory, is quite literally useless, indeed has no meaning, unless it is embedded in a supporting context."

Emphasis on return on investment in research: Rosenberg (1990) argues that "industry has no compulsion to advance the frontiers of science; they are merely lured by the possibility of a high payoff and/or royalties." Siegal et al. (1999) agree that industry only funds research if the firm can validate the potential for commercialisation. It is therefore no surprise that 79% of the respondents surveyed also regard return on investment as an important driver for knowledge transfer in their R&D collaborations. Return on investment is significant to 17% of the 74 respondents, while 36% regard it as very significant and 43% as extremely significant. This finding raises the stakes substantially in terms of determining which projects are most likely to receive industry funding. Universities will thus have to ensure that their R&D proposals articulate the likely benefits that industry will derive from such collaborations.

The need to close the knowledge gap: Bridging the gap between those who have critical R&D information (and the ability to interpret and use it) and those who don't but need it, is one challenge in closing the knowledge gap between universities and companies in South Africa. It is not surprising that 29% of industry partners rate closing the knowledge gap between themselves and universities as extremely significant. Another 35% say this driver is very significant. These findings may reveal the apprehensiveness about the ever-widening gap between what is known and how it is applied or exploited.

The need to extract appropriate knowledge to make good decisions: The results of the survey indicate that respondents believe that extracting appropriate information is an extremely significant (41%) or very significant (41%) driver of knowledge transfer. It is therefore obvious that the greatest number of respondents consider this an important issue.

These results are not surprising. All decision-making depends on appropriate instructive and descriptive information or knowledge that is unambiguous, contextualised and timeous. Yu (2002) confirms this when he writes of "the need for speed of information provision," and Shrivastava (in Kazanjian et al., 2000), who indicates that "knowledge systematisation and grouping, complexity, relevance and timeliness" are critical issues in decision-making.

Impact of international trade: Only 18% of the respondents note international trade as an extremely significant driver of knowledge transfer between universities and industry. Less than a third of the respondents (30%) rate it as very significant and 26% rate it as significant.

Intellectual property protection: Intellectual assets represent one of the strongest forms of intangible value impacting on the knowledge and learning economy (DST, 2002). Only 13% of industry respondents view intellectual property protection as an extremely significant driver of knowledge transfer between themselves and universities. Some 28% of respondents indicate that intellectual property protection is very significant, and a further 26% indicate that this driver is merely significant. These low figures do not, therefore, provide a strong argument to suggest that intellectual property protection may be a highly relevant driver of knowledge transfer in the interface between industry and universities in South Africa.

The impact of war, terrorism and natural disasters: Wars, natural disasters and acts of terrorism are powerful events that should act as drivers of knowledge transfer between industry and universities on research and development collaboration. However, only 21% of respondents consider this driver to be extremely significant. Surprisingly, 21% of respondents consider these issues to be of no significance at all.

Geographic proximity between knowledge source and recipient: Proximity between industry firms and universities promotes the natural exchange of ideas through formal and informal networks (Löfsten & Lindelöf, 2005). This, in turn, increases localised knowledge spillovers (Almeida & Kogut, 1999; Almeida et al., 2003; Zucker & Darby, 1996a). One reason for this finding may be traced to Hansen et al. (1999). Hansen found that knowledge transfer is most effective if "networks of people from universities and industry share knowledge face-to-face, over the telephone, by e-mail and via video conferences." Hansen says that by doing so, people from universities and industry are able to collectively arrive at deeper insights on problems they need to solve. Data obtained in the South African survey shows that

The table below summarises the findings by listing the nine drivers of knowledge transfer together with the rating by South African industry respondents.

Driver of knowledge transfer	Extremely significant	Very significant	Significant	Vaguely significant	Not significant
Knowledge as a valuable resource	48%	31%	14%	7%	0%
Return on investment	43%	36%	17%	4%	0%
Need to close the knowledge gap	29%	35%	27%	9%	0%
Appropriate knowledge to make decisions	41%	41%	17%	1%	0%
International trade	18%	30%	26%	19%	7%
Intellectual property protection	13%	28%	26%	23%	10%
War, terrorism and natural disasters	21%	15%	13%	30%	21%
Geographic proximity	3%	31%	25%	35%	6%
The need to protect knowledge for competitive advantage	37%	29%	20%	13%	1%

only 3% of industry respondents rate geographic proximity as extremely significant. Some 31% rate this driver as very significant, 25% as significant and 35% as vaguely significant. Some factors affected by geographic proximity, according to Hislop (2003), are the type of knowledge involved, the characteristics of the knowledge, the location of the knowledge and how dispersed the required knowledge is.

The need to protect knowledge for competitive advantage: In the competitive environment, firms must have access to a wellspring of new technologies and actionable knowledge (Werther et al., 1994; Santoro & Gopalakrishnan, 2001), because knowledge enables organisational renewal and sustainable competitive advantage (Inkpen, 1996). This being the case, the respondents from South Africa concur with worldwide trends of protecting knowledge assets for competitive advantage. It was noted that 37% of respondents feel that this issue is an extremely significant driver of knowledge transfer; another 29% of respondents rate it as very significant. 20% rate this driver as significant; and a further 13% indicate that this driver is vaguely significant. One possible reason for this finding may be that confidentiality clauses in contracts protect the knowledge domain and prevent disclosure of know-how to competitors without prior consent. This gives a firm a relative advantage over competitors. It is, however, evident that alliances with universities provide firms with a window on their partners' broad capabilities and multiple knowledge reservoirs (Argote & Ingram, 2000) and collaboration allows firms to share the risks, build on shared capabilities and create synergies for better competitiveness (Santoro & Gopalakrishnan, 2001). Industry firms need to know most about a technology when it is new (Robey & Markus, 1998:8, 12), because it gives them a competitive advantage. Universities must take cognisance of this and be proactive in communicating new knowledge.

From these figures, it is evident that the following four drivers have the highest significance rating: perception that knowledge is a valuable resource (48%), return on investment (43%), the need to extract appropriate knowledge in order to make good decisions (41%) and the need to protect knowledge for competitive advantage (37%).

Survey conclusions

Knowledge transfer appears to work best when it is seen not so much as a relay race, but as a team sport. Knowledge transfer is not a process in which the knowledge-baton is kept inside the university during the first few rounds of the race, while it is passed to the outside world only during the last rounds. Rather, knowledge transfer should be "a game during which the ball moves continually between the players and in which all players have to collaborate and share resources to win" (Entrepreneurial Higher Education Institution, 2002:10-11).

If knowledge management is a collection of processes that governs the creation, dissemination, and utilisation of knowledge in an organisation (Newman, 1991), then firms have to provide an enabling environment for the development, nurturing, utilisation and sharing of employees' tacit knowledge (Ajiferuke, 2003:1).

Universities, as providers of scientific research and development knowledge, realise that one role of science and knowledge is to solve problems vital to society, while working for the common good in the most effective way (Brante, 1988:122). Firms and universities need to apply thinking strategies to their surroundings, to increase collaborations and knowledge transfer while ensuring that sufficient mutual benefits can be derived.

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Anthea van Zyl *started out studying Social Work, then moved on to Business Management, Labour Relations and Hotel and Restaurant Management. She then branched away and commenced with a bachelors degree in Information Management, specialising in Publishing. She did an honours degree in Information Science and Knowledge Management (with Competitive Intelligence). Her master's was on the drivers of knowledge transfer between universities and industry R&D partners. She has worked for the Department of Correctional Services, in libraries as an information specialist, has spent time as a business manager at a large manufacturing concern and at two academic institutions in South Africa. For the past eight years she has been involved with the Institute for Technological Innovation at the University of Pretoria.*

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Who's working on it: LG, Philips, Samsung, and Sony

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