



Managing relationships of the republic of science and the kingdom of industry

Jorge F.S. Gomes

Instituto Superior de Psicologia Aplicada, Lisbon, Portugal

Pia Hurmelinna

*Department of Business Administration, Lappeenranta University of Technology,
Lappeenranta, Finland*

Virgílio Amaral

Instituto Superior de Psicologia Aplicada, Lisbon, Portugal, and

Kirsimarja Blomqvist

*Telecom Business Research Center, Lappeenranta University of Technology,
Lappeenranta, Finland*

Abstract

Purpose – This article investigates the reasons for collaboration and the barriers to cooperation between universities and industry organizations. In an increasingly integrated world, cooperation between universities and companies is likely to grow in forthcoming years.

Design/methodology/approach – The approach taken in this article differs from previous works in the sense that it reveals the psychological frameworks that academics and managers hold about collaborating with each other. Data come from a survey of academic and managerial staff working in several universities and companies in Portugal and Finland.

Findings – Overall results show that academics still see companies as information sources for their researches, but they are also willing to participate in joint projects in which academic knowledge is not the sole output.

Originality/value – Provides information for companies and universities with regard to how to embark on such cooperative endeavors.

Keywords Universities, Organizations, Strategic alliances, Communication

Paper type Research paper

Introduction

As a result of the changes that have emerged in the economy in the last decades, companies face new challenges to maintain their competitive advantages. One sign of such challenges is internal R&D losing its relative importance due to the benefits of facilitated access to external knowledge. R&D is, of course, continuously conducted internally, but there is an ever-increasing emphasis on establishing more contact points with external organizations (Chesbrough, 2003). This “Networked R&D Management” approach emphasizes internal and external collaboration networks as critical for companies facing a dynamic business environment: collaboration is seen as a meta-capability for innovation (Blomqvist *et al.*, 2003). Similarly, universities need collaboration, for example to educate experts for the industry, and to raise external research funds to balance their budgets. While companies increasingly rely on joint R&D projects with other firms, universities are becoming engaged in these activities as



well (Hall *et al.*, 2001; Cyert and Goodman, 1997; Pollitt and Mellors, 1993). Since advances in scientific understanding are important sources of technological opportunity, knowledge generated inside universities is likely to become ever more attractive in future.

The basic purposes of universities and companies, however, still remain different from each other. One fundamental purpose of academia is to “produce codified theories and models that explain and predict natural reality”: conversely, business R&D aims to design and develop “produceable and useful artefacts” (Pavitt, 1998, p. 795). Because the aims differ, the means to achieve them are also different. Simplification and reduction of the number of variables to achieve analytical tractability are typical of academic research, whereas industry knowledge is more often gathered through trial and error (Pavitt, 1998).

There are positive and negative outcomes from university-industry collaboration. Studies have explored the barriers to cooperation (Lopez-Martinez *et al.*, 1994), and its benefits (e.g. Behrens and Gray, 2001). Academy-industry collaboration can be seen as a typical situation of asymmetric collaboration (Blomqvist *et al.*, 2003), providing a potential for high synergy and collaborative benefits. However, the parties face many challenges due to asymmetric cultures and management. Collaboration between universities and firms has indeed been widely studied, but the issue is so complex that further research is needed (see, for example, Hall *et al.*, 2003).

This paper aims to understand the motives for, and barriers to, collaboration from the point of view of those working in each environment. In other words, our goal is to explore the psychological frameworks that both academics and managers hold about collaborating with each other. This study differs from previous ones in the sense that it is neither focused on goals and functions nor on strategies and structures, but on the mental and psychological characteristics of those working in academia and industry.

Why must universities and industries collaborate?

Collaboration between universities and companies can lead to several benefits. Nissani (1997) names a few: creative breakthroughs, academic freedom, social change, outsider’s perspective, and flexibility of research. Other reasons include learning from one’s partner, access to knowledge networks, funding (Sáez *et al.*, 2002), global improvement of both management research and management practice (Amabile *et al.*, 2001), and blending knowledge as science and knowledge as culture (Delanty, 2001).

Access to funding is a central motivation for universities to look for company partners. In fact, universities increasingly face constrained research budgets, and/or pressure towards more useful and readily applicable research (e.g. Hall *et al.*, 2003; Cyert and Goodman, 1997). Other incentives arise as well: through collaboration universities get access to empirical data, which makes research more grounded in “real problems”, and increases the likelihood of publication. It is reasonable to propose that important research questions arise in industries facing pressures for strong technological change and global competition. Academics in active dialogue with industry managers may thus spot emerging research issues earlier than their less active colleagues. Know-how in companies may be diffused to universities not only through research, but also through networking, for example when company representatives act as visiting lecturers. In addition to this, final course assignments

and training periods may lead to employment opportunities for graduates, and improved reputation and competitiveness of universities (Azaroff, 1982).

The increasing number of joint projects makes it reasonable to assume that collaborative projects are economically viable for both universities and companies. Companies' motivations for collaboration include getting access to scientific frontiers, increasing and using the predictive power of science, delegating selected development activities, and lack of resources (Bonaccorsi and Piccaluga, 1994; Cyert and Goodman, 1997). First (or second) mover advantages may be available to companies performing basic research, and collaborating with universities may facilitate this (Cohen and Levinthal, 1990). If there are considerable uncertainties related to some directions of development and research projects, companies can choose to share risks with universities. Large-scale testing by universities may be very important, especially when collaboration means avoiding further investment in in-house facilities (Bonaccorsi and Piccaluga, 1994). In today's fast-paced business and lean organizations, there is little opportunity for in-depth analysis: therefore, collaboration with academics may offer well-trained analytical resources to complement corporate business analysts.

Notwithstanding all these advantages, the practice shows that the industry and the university often evolve as two distinct worlds, with rare points of contact with each other. Reasons for this separation are explored in the next section.

Why is collaboration difficult?

Van Dierdonck and Debackere (1988) have identified three categories of barriers to collaboration:

- (1) cultural;
- (2) institutional; and
- (3) operational.

Universities and companies have fundamentally different cultures, which are reflected in divergent goals, time orientations, basic assumptions, and languages used. Additionally, universities deal with work that is abstract, complex and ambiguous: much of the knowledge is tacit in nature, and time spans between project initiation and product creation may be very long. Unclear boundaries in interdisciplinary projects and the gap between researchers and industry representatives may lead to conflicts and disappointments because of imprecise expectations (Bruhn, 1995). Another inherent obstacle to collaboration is related to the fact that the corporate world is subject to unexpected radical changes, such as acquisitions, mergers, and bankruptcies: such scenarios are considerably less likely to happen in the academic world (Cyert and Goodman, 1997).

The aims and interests of different organizations participating in a cooperation venture may differ significantly from each other. Unlike companies, academic parties do not usually pursue profits – rather, they seek science development. Concealment of information fits poorly into the academic environment, because confidential research results cannot be used as merit (e.g. to apply for a position). Dealing with the results of collaboration and making sure that both parties get them in the first place can be dealt with by contracting, but only if it is handled with care. Similar problems and questions arise with respect to other aspects of formalizing collaboration as well, such as forms of

collaboration (Amabile *et al.*, 2001), scope of collaboration (Sáez *et al.*, 2002), or even the quality of research produced (Anderson *et al.*, 2001).

Universities may face some serious difficulties related to collaboration with industry. The threat of research concentrating too much on applied research and neglecting basic research and teaching is often an issue when funding comes from companies. Graduating may take more time, and also the quality of results may be affected so that the academic requirements cannot be met without extra work. Restrictions to academic openness, for example in the form of delays in publication or problems related to confidentiality issues, may emerge (Hall *et al.*, 2003). Accepting funding may also lead to disputes over ownership and use of intellectual property rights (Azaroff, 1982).

One main worry related to collaboration from the point of view of companies is the outcome of collaboration (Pollitt and Mellors, 1993). The benefits achieved may end up being quite insignificant related to the efforts invested in joint research, and the promised technology transfer may not occur (Cyert and Goodman, 1997). The experience of not receiving enough from collaboration may be further fostered if the “not-invented-here” syndrome affects the attitudes of employees so that they do not even want to see the potential of results produced by researchers. Researchers may be unwilling to let unfinished work out of their hands (even though it might be more than enough for companies): waiting for final reports may be also time-consuming. Another risk emerges because universities collaborate with a number of (competing) companies, and unintended flows of knowledge through the university may occur. Losing proprietary information may be harmful as such, but there also is the possibility that obstacles (e.g. to patentability) arise as a result of lack of awareness or attention to these issues.

Research goals

The above literature review illustrates that there are many potential gains from collaboration between the academic and industrial worlds. However, it also shows many problems. The literature has been concerned with describing such reasons at the organizational, institutional, cultural and legal levels, but less empirical work exists from the individual level of analysis. Amabile *et al.* (2001) recognize this when they write: “academics and practitioners may be particularly likely to have different perspectives on research issues” (p. 420).

Since collaboration depends on those directly involved in university-company projects, it is important to understand how the views of key actors influence decisions regarding collaboration. Key actors include academics and managers who, for one reason or the other, embark on cross-professional projects. The goal of the current research is to explore the psychological frameworks that academics and managers hold about collaborating with each other. Mental representations of these key actors are likely to influence the process and the outputs of collaboration (de Sá *et al.*, 1996). In addition to this, this research also looks at differences between two country settings, i.e. Finland and Portugal.

Method

Participants

Participants were 49 managers and academics from different companies and universities from Finland (11 academics and 13 managers) and Portugal (11 academics

and 14 managers). The potential respondents were known to have at least some kind of experience or knowledge of university-industry collaboration. The participation rate was 62 percent.

Qualifications ranged from bachelor to PhD degrees in various areas from psychology to medicine. Table I breaks down the sample into academic training, country, and academic degree. From Table I it can be seen that the sample is biased towards academic training by country: the Finnish sample is mainly composed of individuals with degrees in economics and engineering/technology, whereas the Portuguese respondents are trained in human and social sciences. The diversity of academic degrees is also wider in the Finnish sample.

Tenure also ranges widely, from full professors to company vice-presidents. Variety is extensive as regards previous experience in university-industry collaboration, from being project leader and project manager, to consultancy and training. Differences also exist between countries and origin: in the Portuguese sample, 12 respondents (two of them academics) clearly stated that they did not have previous experience with collaborating with companies or with universities. In the Finnish sample, only one academic revealed a lack of experience with industry.

All in all, these differences in sample composition impose caution when interpreting the results, especially those regarding differences between countries. On the other hand, these differences allow comparison between distinct paradigms of thinking, which stimulates benchmarking and gaining cross-knowledge.

Instruments

A survey was sent via e-mail to several managers and academic staff in Finland and Portugal. The survey consisted of two groups of questions. The first group had three questions and aimed to elicit respondents' beliefs with regard to the issues under analysis:

- (1) Why would universities and companies want to cooperate?
- (2) What are the barriers to collaboration between universities and companies?
- (3) How are universities and companies dealing with the outputs of joint projects?

Each of the three questions produced text material that was subsequently subjected to content analysis (Bardin, 1977).

The second group of questions enquired about biographical data, including gender, position, age, tenure, previous experience with collaboration, academic training (economics, law, and so on), and academic degree (PhD, MSc/MBA, and bachelor).

Table I.
Sample description by country, academic degree and academic training

	Finland			Portugal		
	PhD	MSc/MBA	Bach	PhD	MSc/MBA	Bach
Economics	4	1	0	0	0	1
Engineering/technology	3	6	3	0	0	1
Management/business studies	0	0	0	4	1	0
Organizational behaviour/psychology	0	0	1	2	7	3
Other (political science, law, medical science, language studies, and theology)	0	5	1	0	0	1
Total	7	12	5	6	8	6

Results

Why would universities and companies want to cooperate?

Table II presents the reasons given by managers and academics from Finland and Portugal to embark on collaborative work. The figures after each sentence represent the number of times the particular reason was mentioned.

The most important reason for collaborating is “actualization/competitiveness” (27 hits). This category reflects the acquisition of a competitive edge, or keeping ahead of the competition through collaboration and continuous learning and development. There seems to be no difference between countries or origin (academics and managers). However, there appears to be a difference regarding who is taking more advantage of collaboration: companies seem to have more to gain from collaboration (12 – see bold numbers) than universities (5), as far as actualization/competitiveness is concerned.

“Education with meaning” is the second most frequently cited category (19). This is about the need to deliver education that takes a more practical and useful approach and is more adapted to the needs and problems of society and industrial organizations. This need is particularly felt by Portuguese managers, who seem to believe that there is a wide gap between university life and corporate life. Interestingly, academics (6 hits) also believe that education should be given more meaning. As expected, this category refers to the gains that universities make from collaboration.

Access to funding/financial resources (16), knowledge (14), information (13) and other resources (8) occupy the next places in the ranking. Access to knowledge, for

	Finland	Portugal
University	Access to funding/financial resources: 6 (6) Access to information: <u>1</u> , 5 (6) Access to knowledge: <u>2</u> , 5 (7) Access to resources: <u>1</u> , 3 (4) Actualization/competitiveness: 1, 2, 3 (6) Employment opportunities: 1, 2 , (3) Education with meaning: <u>1</u> , 3 (4) Image: 2 (2) Outsourcing R&D: 2 (2)	Access to funding/financial resources: 4, 1 (5) Access to information: 3, (3) Access to knowledge: 3 , (3) Access to resources: 2, (2) Actualization/competitiveness: 3, 1 (4) Employment opportunities: 2, 1 (3) Education with meaning: <u>1</u> , 7 (2) Image: <u>1</u> , 1, 3 (5)
	Quality of human resources 1 , (1)	Individual gains: 1, (1) Quality of human resources: <u>1</u> , 1 , (2)
Industry	Access to funding/financial resources: 4, (4) Access to information: 3, (3) Access to knowledge: 1 (1) Access to resources: 2 , (2) Actualization/competitiveness: 3, 1, 4 (8) Education with meaning: 4, (4) Employment opportunities: 2 (2) Image: 2, 1 (3) Quality of human resources: <u>1</u> , 1 (2)	Access to funding/financial resources: 1, (1) Access to information: 1 (1) Access to knowledge: 2, 1 (3) Actualization/competitiveness: 3, 1, 5 (9) Education with meaning: 3, 6, (9) Employment opportunities: <u>1</u> , 2 (3) Quality of human resources: <u>1</u> , 2 , (3)

Notes: Underlined numbers indicate a reason for both companies and universities to collaborate; italic numbers indicate a reason for universities to collaborate; bold numbers indicate a reason for companies to collaborate; numbers in parentheses indicate the total number of times a particular reason was mentioned

Table II.
Reasons for collaboration

example, reflects the idea that universities and companies are high-intensive knowledge producers, which can benefit from each other greatly. “Image” (10) is worth pointing out: it reflects the organizations’ reputation, visibility, and social status, which can be gained from being on a joint project.

What are the barriers to collaboration between universities and companies?

Table III presents the main barriers to collaboration pointed out by respondents. The most important obstacles to collaboration were “different needs and objectives” and “attitudes” (15), followed by: “lack of knowledge/experience regarding how to collaborate” and “lack of practical knowledge in universities” (11 each), “different time horizons” (10), and “different language/mental worlds” (9). These key issues are very much in line with earlier research. However, there are differences between the groups.

For example, academics feel that the main obstacle to collaboration are the divergences between what universities and companies want and need (11, with the higher contribution from Finnish respondents), whereas managers accuse universities of having knowledge poor in practical and real applications (8). Lack of practical knowledge in universities is shown in text such as: “professors are ignorant as far as solving real problems is concerned”.

	Finland	Portugal
University	Attitudes: <u>2</u> , <i>1</i> (3) Bureaucracy: <i>2</i> (2) Confidentiality: <u>3</u> , 1 (4) Culture: <i>1</i> , (1) Different language/mental worlds: <i>3</i> , (1) Different needs and objectives: <u>7</u> , <i>1</i> (8) Lack of knowledge/experience: <u>2</u> , 1 (3) Lack of practical knowledge in universities: <i>1</i> , (1) Previous bad experiences: <u>2</u> , (2) Time horizons: <u>5</u> , (5) Unable to explore knowledge: <u>1</u> , 2 , 1 (4)	Attitudes: <u>3</u> , 1 (4) Culture: <i>4</i> , (4) Different language/mental worlds: <i>1</i> , <i>1</i> (2) Different needs and objectives: <i>1</i> , <i>1</i> , 1 (3) Fear of challenging mindsets: <u>1</u> (1) Lack of knowledge/experience: <i>1</i> , <i>1</i> , 1 (3) Lack of practical knowledge in universities: <i>2</i> (2) Unable to explore knowledge: <i>1</i> , (1)
Industry	Attitudes: <u>2</u> , <i>1</i> (3) Bureaucracy: <i>2</i> , <i>1</i> , (3) Confidentiality: <u>2</u> , <i>1</i> (3) Culture: <i>1</i> (1) Different language/mental worlds: <i>1</i> (1) Different needs and objectives: <i>1</i> , 1 (2) Lack of knowledge/experience: <u>2</u> , (2) Lack of practical knowledge in universities: <i>4</i> , (4) Time horizons: <u>2</u> , <i>1</i> (3) Unable to explore knowledge: <u>1</u> , 1 (1)	Attitudes: <u>2</u> , <i>1</i> , 2 (5) Bureaucracy: <i>2</i> (2) Confidentiality: 1 (1) Culture: <i>1</i> (1) Different language/mental worlds: <i>4</i> , <i>1</i> (5) Different needs and objectives: 1 , <i>1</i> (2) Lack of knowledge/experience: <i>3</i> (3) Lack of practical knowledge in universities: <i>4</i> (4) Time horizons: <u>2</u> (2) Unable to explore knowledge: 2 (2)

Notes: Underlined numbers indicate barriers to collaboration (from both universities and companies); italic numbers indicate barriers to collaboration (from universities); bold numbers indicate barriers to collaboration (from companies); numbers in parentheses indicate the total number of times a particular barrier was mentioned

Table III.
Barriers to collaboration

With regard to differences between countries, Finnish respondents give particular attention to time horizons between academics and managers. Bureaucracy is more of an obstacle to the Finnish sample than to the Portuguese sample, and confidentiality is rather neglected in the Portuguese sample, while to the Finnish this looks to be a very important issue.

How are universities and companies dealing with the outputs of joint projects?

The actual question posed to respondents was “How can/are results from collaboration between universities and companies being explored/used?” Table IV shows the main results. The most striking feature in Table IV is the considerable low number of solutions to explore/use results from collaboration, appointed by respondents. This is consistent with the high number of responses in Table III for the category “lack of knowledge/experience”.

The Portuguese sample seems to be particularly productive in pointing to ways to explore results from collaboration between universities and companies. However, this may be due to differences between the two academic backgrounds (more “hard-science” oriented in the Finnish sample, and more “soft-science” oriented in the Portuguese sample). For example, using “media” to expose results from collaboration is a popular output among Portuguese respondents (7), but completely absent among Finnish respondents. In the same vein, “internal reflection promoted” (encouragement to organizational change via feedback and critical thinking) and “consultancy/training” are two relatively common outputs in human and social

	Finland	Portugal
University	Customer orientation: 2 Defining risks: 1 Defining right of use: 4 Internal reflection promoted/change: 3 Involving other levels in collaboration: 1 Publications: 3 Results agreed upon in the beginning: 2	Customer orientation: 1 Company start-ups: 2 Consultancy/training: 1 Financing: 1 Internal reflection promoted: 7 Involving other levels in collaboration: 3 Media: 3 Publications: 2 Results agreed upon in the beginning: 1
Industry	Confidentiality and security: 1 Customer orientation: 1 Defining right of use: 1 Defining risks: 1 Involving other levels in collaboration: 1 Publications: 1 Results agreed upon in the beginning: 3	Company start-ups: 1 Consultancy/training: 2 Customer orientation: 2 Defining right of use: 1 Financing: 2 Internal reflection promoted: 4 Involving other levels in collaboration: 2 Media: 4 Publications: 1 Results agreed upon in the beginning: 1 Training/probation period: 3

Table IV. Exploration/use of results from collaboration

sciences, whereas in economics, technical and engineering sciences, change comes more from technology and processes.

Discussion and conclusions

Although the two samples used in this study are not entirely comparable due to differences in academic backgrounds and other attributes of respondents, the results suggest that cultural (both organizational and nationality-based) differences may have an effect on the associations that academics and managers have when talking about universities and companies.

When considering motivations for collaboration, many results are expected, such as obtaining funding for university research. Some differences between Finland and Portugal can be seen, however. For example, access to information and knowledge ranks high amongst Finnish academics. This may indicate the general acceptance of “knowledge-based competition” in Finland. An educational system closer to the real world is especially central for Portuguese managers. This may be explained by the fact that in Finland, collaboration between the university and industry has been a desirable goal since the early 2000s, whereas in Portugal these issues have only recently been brought to light.

Concerning the barriers to collaboration, confidentiality does not seem to be important at all to Portuguese respondents, whereas the Finnish seem to consider it imperative. This may be due to Finnish respondents thinking more of applied and business-related research, which could alleviate the need for confidentiality. However, since no information was collected on what kind of collaborative university-industry relationship respondents thought about, no definite conclusion can be drawn. Background information about respondents, however, leads to the hypothesis that many of the Finnish respondents had experience of strategic and applied research collaboration related to, for example, partnerships and alliances. In summary, all respondents point out many barriers to collaboration, which reinforces the need to think thoroughly about collaboration if it is to be successful.

Many ways of dealing with the results of collaboration can be found in previous research. However, we found an interesting difference between academics and managers: academics believe that companies can benefit from joint projects because of feedback related to research results, whereas among managers this was nearly completely neglected. More important to managers (especially Portuguese managers) is the announcement of joint projects and/or results in the media. Amongst other issues, these results emphasize the need to think about how feedback is being done after research, and suggests that academics may need to be more creative when presenting their work to companies.

Improving dialogue between the academic and industrial worlds may prove to be a challenging task. Solutions cannot be restricted to individual differences between academics and managers, since, as suggested by this research’s respondents, many of the problems arise from organizational and institutional sources. Based on the findings reported in this text, and on authors such as Amabile *et al.* (2001), Azaroff (1982), Ibarra-Colado (2001), and Rynes *et al.* (2001), Table V puts forward a few guidelines to stimulate collaboration between the “republic of science” and the “kingdom of industry”.

A final note: we have argued that there is much to be gained if universities and companies embark on collaboration projects. Several ways to overcome problems have been advanced, so that in the end cooperation is made easier and more productive.

Knowledge transfer (individuals)	Investigation based on action research and action learning; Master's and doctoral programmes directed at company workers; training probation periods and final course assignments; training and consultancy; classes delivered by practitioners and consultants; joint intervention projects
Knowledge transfer (organizations)	Macro-organizational system: science parks, technological centers, regional clusters Meso-organizational system: business incubators, training centers (in universities), corporate universities, conferences, seminars and workshops incorporating cross-presentations
Internal renewal	Organizational structures and processes which facilitate collaboration (e.g. flat structures and more customer- and client-oriented)
Internal renewal of academic curricula	Academic curricula in line with the needs and problems of society and the world, emphasis on meta-competences (e.g. learning capability, creativity)
External support to collaboration	Governments, public institutions, and transnational organizations (e.g. Finnish <i>TeKes</i> , Portuguese <i>Fundação para a Ciência e a Tecnologia</i> , or the Cordis Programme)
Globalization	Development of the ability to attract foreign students (e.g. Erasmus programme)

Table V.
Guidelines to improve and stimulate collaboration

However, this does not mean that universities and companies can substitute each other in the economic and social systems. They are indeed distinct, have different competencies, and fulfill different functions. It is from this difference that synergies are created and more productive results can be achieved. Equating them would be losing the possibility to achieve such outcomes.

References

- Amabile, T.M., Patterson, C., Mueller, J., Wojcik, T., Odomorik, P.W., Marsh, M. and Kramer, S. (2001), "Academic-practitioner collaboration in management research: a case of cross-profession collaboration", *Academy of Management Journal*, Vol. 44 No. 2, pp. 418-31.
- Anderson, N., Herriot, P. and Hodgkinson, G.P. (2001), "The practitioner-researcher divide in industrial, work and organizational (IWO) psychology: where are we now, and where do we go from here?", *Journal of Occupational and Organizational Psychology*, Vol. 74, pp. 391-414.
- Azaroff, L.V. (1982), "Industry-university collaboration: how to make it work?", *Research Management*, Vol. 25 No. 3, pp. 31-4.
- Bardin, L. (1977), *L'analyse de contenu*, Presses Universitaires de France, Paris.
- Behrens, T.R. and Gray, D.O. (2001), "Unintended consequences of cooperative research: impact of industry sponsorship of climate for academic freedom and other graduate student outcome", *Research Policy*, Vol. 30 No. 2, pp. 179-99.
- Blomqvist, K., Koivuniemi, J., Hara, V. and Äijö, T. (2003), "Towards networked R&D management: R&D management of Sonera Corporation in a dynamic environment", paper presented at the 2003 R&D Management Conference, Manchester, 7-9 July.

- Bonaccorsi, A. and Piccaluga, A. (1994), "A theoretical framework for the evaluation of university-industry relationships", *R&D Management*, Vol. 24 No. 3, pp. 229-47.
- Bruhn, J.G. (1995), "Beyond discipline: creating a culture for interdisciplinary research", *Integrative Physiological & Behavioral Science*, Vol. 30 No. 4, pp. 331-41.
- Chesbrough, H. (2003), "The logic of open innovation: managing intellectual property", *California Management Review*, Vol. 45 No. 3, pp. 33-58.
- Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-52.
- Cyert, R.M. and Goodman, P.S. (1997), "Creating effective university-industry alliances: an organizational learning perspective", *Organizational Dynamics*, Vol. 25 No. 4, pp. 45-57.
- de Sá, C.P., Souto, S.O. and Möller, R.C. (1996), "La représentation sociale de la science par des consommateurs et par des non-consommateurs de la vulgarisation scientifique", *Les Cahiers Internationaux de Psychologie Sociale*, Vol. 29, pp. 29-38.
- Delanty, G. (2001), "The university in the knowledge society", *Organization*, Vol. 8 No. 2, pp. 149-53.
- Hall, B.H., Link, A.N. and Scott, J.T. (2001), "Barriers inhibiting industry from partnering with universities: evidence from the advanced technology program", *Journal of Technology Transfer*, Vol. 26 No. 1/2, pp. 87-97.
- Hall, B.H., Link, A.N. and Scott, J.T. (2003), "Universities as research partners", *Review of Economics and Statistics*, Vol. 85 No. 2, pp. 485-91.
- Ibarra-Colado, E. (2001), "Considering 'new formulas' for a 'renewed university': the Mexican experience", *Organization*, Vol. 8 No. 2, pp. 203-17.
- Lopez-Martinez, R.E., Medellin, E., Scanlon, A.P. and Solleiro, J.L. (1994), "Motivations and obstacles to university industry cooperation (UIC): a Mexican case", *R&D Management*, Vol. 24 No. 1, pp. 17-31.
- Nissani, M. (1997), "Ten cheers for interdisciplinarity: the case for interdisciplinary knowledge and research", *Social Science Journal*, Vol. 34, p. 2.
- Pavitt, K. (1998), "The social shaping of the national science base", *Research Policy*, Vol. 27 No. 8, pp. 793-805.
- Pollitt, D. and Mellors, C. (1993), "Making knowledge work: through closer ties between town and gown", *European Business Review*, Vol. 93 No. 4, pp. 36-7.
- Rynes, S.L., Bartunek, J.M. and Daft, R.L. (2001), "Across the great divide: knowledge creation and transfer between practitioners and academics", *Academy of Management Journal*, Vol. 44 No. 2, pp. 340-55.
- Sáez, C.B., Marco, T.G. and Arribas, E.H. (2002), "Collaboration in R&D with universities and research centres: an empirical study of Spanish firms", *R&D Management*, Vol. 32 No. 4, pp. 321-41.
- Van Dierdonck, R. and Debackere, K. (1988), "Academic entrepreneurship at Belgian universities", *R&D Management*, Vol. 18 No. 4, pp. 341-53.

Further reading

- Miller, W.L. and Morris, L. (1999), *Fourth Generation R&D: Managing Knowledge, Technology, and Innovation*, Wiley, New York, NY.
- Teresko, J. (1997), "Winning by sharing", *Industry Week*, Vol. 246 No. 2, pp. 74-9.