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Promoting Better Public-Private Partnerships

Industry – University Relations

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Background and Purpose

This paper considers the changing nature of university-industry relations within universities' role as major platform for creating knowledge and for developing human resources. It is written in preparation for the January 2004 Ministerial level meeting of the CSTP, which will address the interface between science and innovation systems and human resources for science and technology. The paper offers some suggestions for improving innovation systems through institutional reforms and better industry-university relations and ends with a number of questions affecting all players within the innovation systems.

The quality of all our economies depends on their ability to acquire, protect, translate, combine and apply knowledge. This knowledge is needed to solve today's problems and to prepare the ground for solving tomorrow's. Without new knowledge and new combinations of knowledge, there will be no innovation.

Whereas in the past, countries' innovation systems were relatively independent and their companies, universities and public authorities performed quite different roles in generating, applying and controlling the flow of knowledge, today there is much greater interdependency and boundaries have become less clear-cut. We know that in many fields the linear model of research and development is no longer an adequate description of events. Corporate laboratories can no longer satisfy the same functions as in the past. The same can be said from the academic perspective. Today's modes of knowledge production and knowledge application depend on networking, multidisciplinary approaches and interaction with practical problems.

Thus, knowledge has become more mobile, not just through information technology. The best creators of new knowledge move where their efforts can be most fruitful; innovation comes from combining more knowledge and from multiple sources; and, increasingly, new discoveries are thereby transferred rapidly and directly into industrial developments.

We see these as the inevitable consequences of globalisation, market liberalisation and the nature of new technologies, which affect both industry and universities. Connectivity, excellence and focus have become essential to the success of any company, country or institution – no matter how small or large it may be. With greater emphasis being given to the economic role that universities play, it is therefore important to address these trends in terms of the opportunities they create and thus to identify ways to use them for common benefit.

1. Introduction

The basic functions of universities are to create knowledge through research, to act as long-term guardians of this knowledge, to transmit it to others through education, and to train new researchers. Such work does not necessarily or immediately give rise to industrial applications or energize the economy. Provided there is sufficient stability and strength-in-depth, universities can engage in research that is outside the scope of companies and provide society with different skills than will be acquired within industrial careers. These are fundamental and crucial features of any developed society.

But of course universities are also expected to (and do) make direct and indirect contributions to economic performance and they have collaborated with companies for many years as an integral part of fulfilling their basic functions. Today, the nature of these collaborations is changing as the need for effective co-operation becomes more important. Efforts are being made to strengthen this process in order to more actively develop new applications for knowledge as it is created and to better reflect the current state and needs of industry in the educational curriculum. By these means, it will also be possible to strengthen the competitiveness of both universities and industry.

The questions are really how far this process shall be taken and what the consequences shall be for the way in which each of the partners operates. Answering these questions depends on having an adequate assessment of future resource requirements, for example the number of trained people, required areas of excellence, etc. and an understanding of the existing and desired relationships and levels of trust that exist between the partners. Reforms are likely to be necessary at all levels.

In order for the process to be effective, it is also important to establish the basic principles within which institutions will operate in future. We suggest the following:

1. The most important requirement is for excellence, and this must be interpreted within a context of diversity: of discipline, approach, stage and manner of application. Each academic institute, just like a company, must identify the niche where it can achieve excellence in respect of some or all of its research and teaching functions.
2. Whereas collaborations between universities and industry are valuable and have become more substantial than in the past, these serve to extend and enhance, not replace the distinct primary roles that the players exist to perform.
3. Partnerships will add value by combining strengths and overcoming individual weaknesses and equal partners will expect to know what the other seeks to achieve and how this will happen. No long-term benefits can be expected by encouraging collaborations that do not build on strengths, that permit hidden agendas, or that require numerous players to work

together on tasks that are better done by one or two.

By establishing principles such as these, each country can seek to obtain the strong institutions and achieve partnerships between universities and industry in which the basic understanding of what is expected will be clear and effective.

2. University reform

The guiding principles of institutional transparency, accountability, performance and effectiveness are by now widely understood and accepted. To the extent that an institution receives funds from others, it knows it must justify how it uses these funds. Because there are others that could in principle also undertake similar work, it must demonstrate to itself and others that it does the best job possible according to its mission. Systems are required to ensure that these principles are met, but such systems need not be overly onerous.

An industrial perspective can suggest some areas where improvements seem desirable.

(1) Improved management methods

Without pretending that the management of a university corresponds to that of a company, it seems clear that universities can benefit from more professional management. To achieve this, universities might solicit experts from outside academia to serve on management councils and as directors. Private-sector methods for personnel and performance reviews and for organizational management are often very transferable to other situations. Furthermore, to the extent that a university wishes to partner with industry, it is essential to establish the professional skills within the university capable of handling these partnerships, for example in the area of technology licensing, a point which is discussed in more detail later.

(2) Strengthened leadership

One of the key characteristics of a university is its fierce defence of academic freedom at individual and institutional levels. This freedom and autonomy are essential features of academic progress, yet can, at first sight, appear at odds with a requirement to work more closely with others. The way to overcome such problems is through good leadership.

In order for an institute to undertake major reform, for example to accommodate new social needs and plan more strategically for the medium term, the authority of the university president as the chief executive must be strengthened, and appropriate management systems obtained based on a flexible but top-down approach. This enables the president to represent the university

to internal and external audiences in committing to and being accountable for the plan and to champion the process of setting clear goals and desired reforms.

(3) Mobility and Personnel Exchange

With knowledge diffusion becoming so important, it is essential to ensure sufficient human mobility. In the extreme situation, some countries face the so-called inbreeding problem where a high share of university teachers are graduates of the same university, an issue that is emphatically viewed as impeding the development of broader perspectives. Even in general, there is less movement between institutes, across national borders and between industry and academia than seems necessary to support and achieve the desired levels of excellence and awareness.

Exposing university teachers to the needs of industry (and vice versa) can influence the choice of research topics and the education of both new and experienced research workers, thereby helping to create and staff research portfolios that are more attractive and relevant to societal needs.

For this reason, efforts should be made to promote mutually beneficial exchanges between industry and academia. This can take the form of allowing private-sector employees to become university teachers or to serve for a limited period in such capacity or as a second job, of transferring university teachers into the private sector full or part time, of accepting each other's researchers, and of accepting interns. These are established practices in some countries, and can be applied more widely.

In order for this to become commonplace, mechanisms are needed for crediting the time spent in different settings and for handling the different parameters against which academic and industrial careers are assessed and results handled. Practical issues such as pension entitlements and confidentiality become important. With most multinational companies having many years experience of managing international careers and joint industrial projects, they are a possible source of expertise on these matters.

(4) The Societal Recognition of Research Careers and Issues of Supply and Demand

Taking the last section into more depth, many countries now face problems associated with the development of research careers. It is essential that a sufficient number of talented people enter technical disciplines and recognise the value of such disciplines as the foundations for much if not all of their careers.

Many countries struggle with the gender imbalance, leading to a serious loss of human talent

consequent upon having low female participation in research, in particular at more senior levels. Here it seems that industry cannot yet offer a role model, and we must seek another way to overcome the problem.

Stability of demand is also a concern, given the tremendous upheavals taking place within industry, the major source of employment for many researchers. With the nature of careers in research changing quite dramatically, there is a growing need for people who can combine flexibility and entrepreneurship with the traditional skills required within research.

In some countries, there has been a clear tendency towards devaluing the standing of academic careers and towards establishing patterns of employment that are unlikely to achieve the long-term strength in depth that the nation and its industries will require. The low pay, low status and career uncertainty that are often experienced today among academics aged between 30 and 40 can hardly encourage the next generation to follow similar career paths.

These are complex matters to solve, as the attractiveness of science and engineering are often established at a very early age, and reinforced by social values and expectations. But solutions must be found. It will not be sufficient simply to achieve a supply of trained research workers that meets the measured demand today. We expect economic growth to be stimulated by the creation of new types of business emerging from clusters of innovation around leading centres of knowledge. An improved quality and supply of human capital will itself help this process to occur, provided barriers are removed.

3. Basic Policies for Strengthening the Functions of Universities

3.1 Securing diversity

We have noted that the single-track flow of innovation from basic research to application research, development research, and commercialization has ended. There is a need to establish flexible, multi-track and fast-paced innovation systems which encourage cross-disciplinary research and development and the feedback of the market's needs into basic and application research. This, however, must be achieved without creating a belief or expectation that all future requirements can be foreseen and major breakthroughs planned, or that there are any universally-valid single solutions.

The basic point is that the division of responsibilities between universities and industry is becoming more sophisticated and complex. While universities still tend to specialize in more basic research and companies in application and development, this distinction is not clear-cut. Universities now play a key role in forming consortia between industrial competitors in order to achieve excellence in

specialist fields, and they are expected to stimulate the formation of new spin-out companies. What is important in this context is to assign creative responsibility for research themes, curricula and faculty management to individual universities and/or clusters of universities, and to achieve overall diversity through competition.

This means that universities will have to agree among themselves and often through dialogue with industry, the nature and optimal location of specific centres of excellence. This may create tension with the tradition of autonomy, but self-regulation of a network of autonomous institutions is likely to prove more effective than top-down administration. Whereas the government is certainly a partner in this process, its role at this stage is to support and enable the choices that universities have made, not to dictate both the approach and the direction.

So we strongly hope that universities will reaffirm their founding principles, while restructuring themselves to be distinctive, such as by achieving world-class standing in certain fields if not in all fields. This will be also useful from the viewpoint that scarce funds for education can be used as effectively as possible.

3.2 Partnerships between industry and academia for the application of knowledge and strengthening dissemination functions

The dissemination of knowledge based on contracts with technology licensing organizations, the promotion of joint research, and start-ups originating in universities are among the means by which knowledge benefits society and leads to innovation.

What we feel should take centre stage in this process is the development and supply of highly skilled human resources. In addition, for universities to increase their international competitiveness, the establishment of competitive research themes will be important. This will in turn further strengthen partnering between industry and academia from the stage of selecting research themes.

Universities should also strengthen disclosure toward domestic and foreign audiences, including students preparing to enter universities, on their educational programs, research results, and distinguishing features to encourage goal development by students and to increase the number of foreign students studying in their nation.

Whereas some universities may choose to enter into short-term contracts with industry that are oriented towards technical service, we feel that this is not a desirable trend in general as it detracts from developing truly competitive strengths and often relies on previous public subsidies to attract low-cost business into the institute.

Among the key issues to be addressed are the management of joint research and the ownership and

management of intellectual capital. Once again, these are issues that are best addressed through professionalism. As companies start to place a more strategic value on longer-term collaborations with universities, good practices include concentrating this collaborative activity into fewer, larger centres, based around groups with proven track records. Provided it is possible to establish formal intellectual property agreements that meet the needs of both the company and the university, companies are willing to set up rolling contracts covering business/technical goals that will provide security of funding and enable the recruitment of high quality academic research staff. Closer working leads to more effective technology transfer; enables staff exchanges, secondments and recruitment; and permits the involvement of university staff in company training courses and staff development.

It has become clear that few early-stage patents have generated much money for a university, because so much work remains to be done to determine the true applicability of the findings and to implement these in commercial products. It is also clear in many fields that important forms of intellectual property are best protected in other ways, for example as trade secrets. Consequently, it is unhelpful for universities to give too much attention to protecting knowledge through patents. By the same token, it is unreasonable for industry to expect a free transfer.

Universities should indeed be encouraged to protect knowledge with a view to future commercialisation, but this process must be managed by those who have the required experience. It is very important that the university takes a strategic, top-level view of this activity.

Today, new questions are being asked about the mechanisms that shall be used to protect intellectual property. The balance to be struck between encouraging the development of new knowledge for general societal benefit and protecting that knowledge to secure commercial advantage will depend on the nature of the knowledge, the way in which it is brought to market, and the needs of key customers. Developments implemented through long-lived capital investments require different approaches than those which are more ephemeral or where there are critical market failures.

As we have noted in previous papers, we believe existing structures for handling intellectual property are capable of responding to the issues and concerns that exist. Many of the concerns now being raised suggest insufficient understanding of existing systems and of the unintended consequences of well-intentioned changes. It is clear that, when knowledge becomes king, an adequate understanding of intellectual property rights is essential. In part, this can be addressed by giving more attention to the subject within the general university education. We recommend that all science and engineering students at least should be trained in the basics of IPR.

4. Enhancing Educational Systems

We look now at the educational role of universities and the need to ensure that this role is handled in a way that reflects the demands of future full-time employment.

4.1 Strong basic skills

There is a clear need to prepare people with the technical, cultural and social skills they require throughout their professional careers. Firms look for young people who combine good basic training with professional and personal flexibility and breadth. It is important that university courses serve to strengthen these skills. This demands a wide basis of knowledge and sufficiently coherent course work.

Firstly, there is the need for a general understanding of mathematics, the physical and natural sciences, communication and expression, and the humanities. Secondly, efforts should also be made to expand interdisciplinary seminars involving the different sciences and humanities. For example, understanding of the international context within which research and innovation occur, approaches to issues such as ethics in science, and (as mentioned above) intellectual property rights and other aspects of professional research management have become important parts of the educational toolkit.

Of course, this process must begin before young people reach the stage of university. Similar principles apply also at high school level: a modern curriculum, attractive teaching material, adequate ICT support and, above all, well-educated, properly-paid and enthusiastic teachers.

4.2 Practice-oriented education

It is hoped that some universities will develop practical educational programs that reflect the diverse needs and realities of life in the business sector and establish courses that reflect current and likely future conditions in industry.

In return, companies should promote an understanding of the current state of industry through such measures as internship programs and the assignment of their employees as teachers to universities. Industry can also help schools by providing examples, cases, material, guest teachers, and opportunities for company visits, information about career possibilities.

4.3 Professional education

For knowledge to cross the so-called “valley of death” between university research and its application in industry and be coupled with industry as innovation, we need a variety of appropriate instruments for cooperation between universities and industry. Among those instruments are professional educational programs to support the technical knowledge and management skills

needed to commercialize such knowledge.

There will be a growing need for universities to assume responsibility for lifelong learning. Clearly, this must be achieved in ways that are convenient for working adults in such areas as course periods, course subjects, day or night courses, and e-learning. Emphasis should again be placed on the principles of flexibility and creativity, for example underpinned by local competition among individual universities.

4.4 Student participation in joint and contract research

In light of the growing trend for partnering between industry and academia and such environmental changes as the improvement of contracts, joint research between companies and universities has taken off recently. It is our understanding that the promotion of joint and contract research between industry and academia and the participation of students in such research will be extremely effective in developing human resources who can contribute effectively to industries' needs and who appreciate the benefits of this type of career. Further efforts can be made to promote joint and contract research through measures such as the use of corporate facilities.

4.5 Life long learning and the transition to industry

In the context of borderless markets, companies and nations are engaged in fierce competition and depend on human resources that are, and remain, highly skilled. In the past, a key task for universities has been to develop these resources to a point where industry and institutes could take over. There is already the trend towards educational policies where a substantial proportion of the population continues its education beyond graduate level. Increasingly, this will turn into a life-long relationship.

There is a particular need for better career advice for the post-graduate talent pool. Universities need to assist their graduate students in finding appropriate first appointments in industry. Models of good practice exist in some countries (for example in France), and show how this process can be managed.

To re-emphasise points made earlier, stronger industry-university partnerships will lead to a better mutual understanding of developments and needs and this will help create the conditions that can contribute to life long learning.

5. Roles of Government

5.1 Establishing a competitive environment between universities based on excellence

To maintain free competition between universities, impartial evaluation is indispensable. This evaluation and the disclosure of results should be implemented steadily by third parties according to authorized evaluation regimes. To accompany the introduction of after-of-the-fact monitoring based on evaluation, before-the-fact regulations should be eased further, such as the need for government approval in establishing faculties or departments.

The quality of graduates from universities should be strictly monitored and guaranteed as a condition of graduation. To secure international equivalence for educational programs and to improve their quality, it will be important to enhance evaluation and accreditation programs and to strengthen international linkages.

Care has to be taken to avoid the risk that these evaluation processes shift from adding value to becoming burdensome and regressive. Some countries (for example the United Kingdom) have gained considerable experience of what is appropriate in the first and subsequent phases of a programme of national evaluation. We recommend that these lessons be disseminated and understood.

5.2 Enhancing the efficient support of outstanding education

There are urgent issues to address in order to achieve a sufficient supply of, and training for, skilled human resources within industry. Government attention will be required. The process should involve prioritized support and reflect the principles of competition.

Support of the development of new curricula for fostering highly skilled human resources needed in the future should be based on public solicitation, should conform to a transparent selection process, and should efficiently allocate resources for outstanding education. Support of the development of human resources should give top priority to the expansion of scholarships and other financial support for students and researchers. This process should be changed to a system whereby those universities that demonstrate their appeal by gathering many students and researchers through competition will benefit from higher tuition income. In addition, the direct support of universities should be changed to a system that takes into account third-party evaluations mentioned above.

Ideally, the government is required to limit its interference to quality control and, unless this would result in obvious market failures, to leave it to market forces. Excellence would then be shown and proven in practice: clients (students, industry) will demonstrate by their behaviour what they consider to be the best universities in a certain field.

5.3 Encouraging joint investment

It is important that funding and regulatory systems be responsive to the tendency towards closer collaboration between industry and universities. Some innovation regimes create an imbalance between regional development, national expectations and the international organisation of business. This can take the form of barriers to the participation of multinational companies in joint programmes, of implicit assumptions that local clusters fall within (rather than across) the boundaries of single national jurisdictions, and of contradictory rules (for example concerning state aid) at different stages of the innovation process.

6. Conclusions

In addressing the development of industry-university relations, this paper has addressed a broad range of issues, many of which are systemic in nature and require systemic solutions.

We have entered a period where simultaneously the role of knowledge has grown, where complexity has increased, and yet where there is every risk of prolonged economic downturn. There is a need for each country to reform its science system and to vigorously promote the development of its human resources to take advantage of a global pool of knowledge and in the face of global competition. The continued success of business depends on making creative and effective use of science and technology. Universities will be key players in determining this future success.

Recognising that all players need to reform in order to achieve the desired outcome, the business sector will continue to promote partnerships between industry and academia, while seeking effective solutions to questions such as the following:

- This paper has concentrated largely on reforms and improvements in universities. What improvements can industry itself accomplish through the help of universities? Can (for example) industry learn from universities how to better identify and explore long-term themes? Can companies themselves maintain a high level of investment in research as a long term strategy? Successful industry-university co-operations can indeed make it more attractive for companies to invest, given the added value achieved by matching and aligning efforts from the public sector.
- What management skills must be developed in those charged with establishing and overseeing joint industry/university programmes? How shall industry ensure it can accurately and consistently evaluate the quality of research programmes and areas of joint investigation?
- Does industrial collaboration promote too much undesirable bias towards applied versus basic research and how can this be avoided?

- How, in this international context, shall university/industry partnerships manage the apparent conflict between the professional obligation to peer review through open disclosure and the protection of potentially valuable intellectual property?