Executive Summary

1. Universities and Companies have different goals and values. Nevertheless, some of their objectives, such as successful research in science and engineering, occupy common ground. In such cases, it makes sense to manage the overlap carefully; the economy will benefit from a strong relationship between business and universities in these areas of overlap. It is important, however, that business goals should not displace the goals of the Universities. In particular, university research is often motivated by intellectual curiosity, and knowledge is valued in its own right. Eroding this culture would be detrimental to the society and to the economy. It is questionable, for example, that business drivers in the 1950's would have lead us to explore the structure of DNA, an activity which generated the knowledge which now underpins huge value to society and the economy.

2. Overlapping research goals can be managed through *'Technology Development Roadmaps'*. These roadmaps should be developed jointly by universities and business. Areas of common interest could be established by inviting businesses to define their scientific and technological 'Grand Challenges', and then to communicate these challenges openly to the university community. While companies should describe the scientific problems, they would not prescribe the approaches universities might take to develop solutions to these problems. Furthermore, the list of Grand Challenges should not set the limits to the domain of university research.

3. Management of Intellectual Property rights is a critical issue in the relationship between universities and companies. It determines the speed of knowledge and technology transfer or whether it even happens at all. Schlumberger has examples where collaboration has been impeded or even halted because of failure to reach agreement on IP. For direct collaboration to make sense it should lead to a competitive advantage for the company involved. Hindering such competitive advantage will damage or destroy the relationship with the university. This condition need not compromise the university's goals. Companies should seek the *minimum* rights that are compatible with augmenting their competitive advantage.

4. Universities place too much emphasis on the creation of "spin off" companies to commercialize their research. Many of these companies fail in a few years, some because the underlying technology was not commercially viable, but many others because of inexperienced management and a lack of cash flow. We understand that the creation of a start-up is an attractive, low-risk, option for the academic entrepreneur. However, the long-term benefit to the economy may be better served by encouraging universities to work more effectively with established corporations that have the management experience and customer base required to commercialize new technology. The government has a crucial role in setting an effective framework for universities and existing companies to collaborate and share in the rewards of this teamwork.

5. We believe that universities should take an active role in promoting technical careers for women. This is a significant problem in the physical sciences and associated engineering disciplines. Universities in the U.S. are proactive in this area; universities in the U.K. often are not. For the greater benefit of society, the best and brightest people, no matter what their gender, should be encouraged to pursue careers in science and technology.

Background Information

Technical Collaboration with Universities

Schlumberger (www.slb.com) is the leading supplier of technology and information services and solutions to the international oil and gas industry. We have a deep understanding of solutions that optimize our customers' performance, gained through a 75-year history of developing and deploying innovative technologies throughout the world. Schlumberger has more than 75,000 employees of 100-plus nationalities working

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in 140 countries. There are 23 R&D centers employing 3500 scientists and engineers in 9 countries. In the UK we have[1]

Cambridge Research (110)
Schlumberger House – Gatwick (120)
GeoQuest Software Development – Abingdon (100)
Drilling Engineering Center - Stonehouse (50)

Each year Schlumberger spends about 1% of its total R&D budget on joint projects with Universities. These funds are approximately split as follows:

$5M – comes from the budgets of our R&D centers. Of this, $4M is spent in a "bottom-up" mode - individual scientists and engineers identify an academic contact and a decision is made (at the Project Manager level) to support a project at the university. The remaining $1M is allocated by the Schlumberger Moscow Research Center located on Moscow State University Campus. Their charter is to carry out joint research with Russian universities. Almost all of these projects have annual budgets between $25K and $125K.

$2.5M – is a Corporate Grant to Stanford University to support the Global Climate and Energy Project (G-CEP). The duration of this project is 10 years and Schlumberger has partnered with ExxonMobil, GE, E.ON, and Toyota. The total amount of funds committed by this industry consortium is approximately $300 million. The project is managed by Stanford and was launched in November 2002:

http://gcep.stanford.edu/

In addition to the $7.5M above, commercial projects can be conducted with universities or their commercial arms on a case-by-case basis. In this case the funds come from our operations rather than R&D budgets. In the UK, Schlumberger is spending a substantial sum on information network software and hardware development with Parc Technologies (a spin-off from Imperial College).

Answers to the questions below are based on our experience with projects initiated by our R&D Centers (the $5M above) and with the "special opportunity" projects.

European Union: Schlumberger participates with universities and other companies in a large number of EU funded projects. In 2002 we were involved in Research and Technology Grants of approximately 20M Euros. All of these projects involve one or more university partners. With the addition of Training, Technical Assistance and Development Bank grants, our total participation level was just over 30M Euros. In 2002 30 scientists and engineers worked at our European R&D Centers with full EU support.

[1] The number of employees at each Center is indicated in parenthesis.

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Recruiting for our R&D Centers

We have a history of being proactive in recruiting top technical talent from universities around the world. We have identified a list of 45 universities worldwide where we focus our recruiting efforts. An upper level manager is assigned as Schlumberger "Ambassador" to each university and oversees relations. His/her efforts are supported by a local team that maintains continuous contact with key departments and student groups. In the UK there are four Ambassador Universities:

University of Cambridge – Andrew Gould, Chairman and CEO Schlumberger
Imperial College – William Davie, Director Knowledge Strategy
Heriot-Watt University – Alison Goligher, General Manager Schlumberger Oilfield, UK
University of Manchester and UMIST – Brendan Connolly, General Manager, SchlumbergerSema, UK

A particularly valuable part of our recruiting effort is our Internship Program, which brings top students into all of our R&D centers for vacation training. An additional benefit of this program is the link that the interns give us to research being done by their faculty advisors. We have a number of examples of joint R&D projects that were initiated through the intern relationship.

Questions for Consultation

1) We would like to identify international examples of best practice and excellence in business-university collaboration. Some examples of the types of collaboration that we would be interested in hearing about include:

- **Industry's use of the information contained in academic publications, and academia's use of industry patents and prototypes or vice versa.**

  We make extensive use of articles published in the open literature and have a Technology Watch program.

- **Joint ventures between universities and business, for example, personnel exchange or collaborative research and development projects.**

  The most successful collaborations are those where work is being done both at the university and at our R&D Centers. The greater the degree of involvement by our scientists and engineers, the greater the chances for success - simply giving money to the University does not work (we have tried this approach). Our most effective collaborations with Universities have involved the exchange of personnel, usually our scientists spending 1 -> 2 years on campus. Examples are Micro Electro-Mechanical Systems (MEMS) research at Caltech and Magnetic Resonance research at MIT and the University of Cambridge. We have also had university professors spend their sabbatical [6 months to one year] at our R&D centers with significant benefit.

- **Informal contacts, for example, meetings and conferences, use of science parks, business-university liaison, industry sponsored university posts or studentships, work experience for students, business contributions to curriculum development, academic secondments in industry and provision of continuing professional development training by universities for business.**

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Many universities have Industry Liaison Offices – which have assisted with the development of links with industry. However, information about university research programs is available on-line as is faculty contact information. Generally, university professors are quite willing to talk to people from industry and formal introductions are not required. In summary, we believe that there is much more potential for developing a deeper understanding between industry and university than is currently being realized through existing Industry Liaison Offices.

Industry sponsored university posts in the form of "endowed chairs" have value in terms of "corporate image." In addition they can provide important access to the research being done in a key department. For this to be useful, however, the sponsoring company has to commit to a relationship with the professor and stay involved with his interests and students. Sadly, there are many examples of companies that have endowed university chairs but have not maintained the relationship and have not seen any benefit.

Secondments between industry and universities have proven to be quite valuable. Work experience for students is very important and is an essential part of our recruiting strategy. This can take the form of summer internships or longer term "industrial placements".

- **Formal contracts, for example, the use of licensing, research contracts, consulting projects, establishment of spinout companies, product testing, or business support.**

We do not usually pursue formal "Contract Research" with universities because we do not want to be in the position of restricting publication (especially by students) of the results. The best framework for proprietary collaborations is a consulting agreement in which the professor is paid directly for his/her expertise.

Schlumberger has considerable experience in joint R&D projects with universities and companies around the world in which the publication and/or patenting of technical results are encouraged. We have observed that universities are increasingly asserting the right to ownership of the intellectual property (IP) generated in the project.

In the past, US universities were willing to agree that the sponsoring companies owned the IP developed in connection with commercially funded research. Within the last 15-20 years, the success of the universities like Stanford and MIT in commercializing certain biotech patents has convinced most US universities that Technology Transfer can be a significant source of revenue. Accordingly, many universities now insist that all IP developed at the university must be owned by the university. Some universities go so far as to say that the sponsoring company receives no right to use the technology commercially without first negotiating a license with the university. [Inevitably, this will result in a reduction in industry sponsorship.] Schlumberger has examples of agreements under which the IP is owned by the University with certain provisions, but we believe that commercialization or investment in joint research could be negatively affected, thus reducing the subsequent benefit to the economy as a whole.

European universities are often not concerned with IP ownership. In France, development contracts traditionally provide that the university owns any software developed, but the sponsoring company retains ownership of the IP. More recently, in the UK, some universities are taking the "we own all the IP and you need to come to us for a license to use it commercially" approach. As in the US, we believe that this will be counter-productive in the long run. While encouraging universities to value the IP associated with their academic work is desirable, the value to the economy as a whole is ultimately realized when the technology is commercialized. Each party in the development and commercialization of R&D should recognize the value that the other

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party brings to commercial success. The decision on whether to conduct R&D with a university is obviously affected by ownership of consequent IP rights. **Negotiating the terms of engagement between companies and universities is crucial for a successful commercial project that ultimately benefits the economy as a whole**. Companies seek collaboration to improve their ability to compete. Establishing contracts between businesses and universities that hinder this aim will inevitably be counter-productive. The needs of the universities and business, and ultimately the economy, are best served by companies seeking the *minimum* IP rights which are compatible with their need to improve their ability to compete. Schlumberger will be pleased to share its experiences in developing successful contracts for commercializing R&D work done in collaboration with universities in follow-up to the open debate phase of the review.

2) We would also like to understand the main barriers faced across a range of countries to starting or strengthening such relationships. These might include:

- **Management and organisational issues. How can businesses and universities best organise themselves in order to benefit from each other's resources? What mechanisms for priority setting, decision-making and funding in the university sector help business-university collaboration?**

  Funding agencies can develop dedicated programs to support university-industry collaboration. An example is the U.S. National Science Foundation GOALI (Grant Opportunities For Academic Liaison With Industry) Program. In the UK, Schlumberger has benefited from active participation in several EPSRC/DTI funded LINK programs to initiate and grow university collaborations. More generally, one of the criteria for funding of research proposals should be the degree of "industrial relevance" of the research. As mentioned in question 1, the terms of engagement need to be well-defined by companies, universities and the governments that contribute to the funding of the universities so that the development and commercialization of technology is optimized in a spirit of open collaboration that rewards companies and universities and benefits the national and international economy.
  Information technology should be employed to overcome barriers and improve transparency and openness of the relationship between university and business.

- **Technology transfer. What are the barriers? How can it be made more effective?**

  Individuals in university Technology Transfer Offices often operate with inappropriate incentives. They are rewarded for the number of patents generated by their office and for the number of "spin off" companies formed by the university. This is true despite the fact that most of these patents have no commercial value and many of the newly formed companies fail within 3-4 years. They appear not to appreciate that the most economically effective path to commercialization is often to work with an established company to commercialize the technology developed at the university. With this approach they can take advantage of an experienced management team, a strong brand and track record of successful technology deployment and support and an established national and international customer base. There is an intermediate position in which the established company takes an equity position in a spin-off formed by the university and works within it to bring the technology to market. By working outside the mainstream corporate "process", focus is often enhanced and the time to commercialization reduced.

- **Intellectual property. Are the national and international arrangements understood and appropriate?**

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In our experience, both national and international IP agreements are reasonably well understood. However, we do have reservations about the strategy pursued by many university Technology Transfer offices. Obtaining comprehensive and appropriate IP protection for technology developed at a university is both difficult and expensive. The best patents not only disclose and claim important technologies, they are also directed toward clear current or future commercial markets. Making these decisions is difficult for a university or a commercial enterprise having a relatively narrow focus [e.g. a spin-off company]. Further, managing this process for a large university is challenging - while it is possible to obtain adequate IP protection using a shotgun "patent everything" approach, the cost is prohibitive. The best university patent portfolios typically result from close collaboration between the university Technology Transfer office and their counterparts in one or more companies.

3) A third set of questions relates to how business can attract the best graduates and postgraduates with the skills that they require, especially in technology. Questions for business and agencies outside the UK include:

- **How do businesses, individually or collectively, communicate their needs for specific scientific or technical skills and for the development of relevant courses in their local universities?**

  Through the Ambassador Program, we communicate our needs directly to faculty and administration. Generally, we do not seek to specify course content. We do try to emphasize that we are looking for teamwork, communication skills, and a commitment to continued learning and growth. We have examples of providing experts to teach certain specific topics at universities. (e.g. Certain subjects in the MSc Petroleum Engineering course at Imperial).

- **How are attractive career paths for science and technology graduates and postgraduates currently developed in your country?**

  Our approach to Career Development is multi-dimensional and allows people with technical training to move between different R&D centers worldwide and between R&D and Operations where they can work in different functions in numerous business segments. For those who remain within R&D, we have a well-defined "Technical Ladder" for career progression.

- **Does business communicate its needs for skilled graduates and postgraduates to their local universities? If not, what more could be done to facilitate such a dialogue?**

  Schlumberger communicates its need for skilled graduates and postgraduates directly to universities around the world through our Ambassador Program. We regularly send our scientists and engineers to campus to give technical presentations. In addition, we often sponsor "Open Days" where we demonstrate our technology to larger groups of students.

  A particular issue of interest to Schlumberger is the need for activity to promote technical careers for women in technical fields. Schlumberger organized a specific day at our Cambridge Research Center at the end of 2002 where women from universities in Europe were invited to discuss issues related to technical careers for women.

  Schlumberger would also like to work with government to ensure that policies are designed to ensure that students are encouraged to study subjects and work in industries that improve the benefit to society and the economy as a whole. For example, the cost and reliability of energy supply is crucial to economic growth. Skilled graduates and postgraduates working in energy companies can develop and deploy technology that reduces the cost of producing energy and improves the reliability of energy supply.

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Furthermore, this energy technology can also be developed with a view to sustainability and reducing impact on the environment. We believe that these are issues which deserve the attention of some of society's best scientists and engineers and if governments and universities agree, policies can be designed to encourage the best and brightest to work on these technological challenges.

4) The review team will also want to understand what lessons can be drawn from financial considerations in a range of countries that help or hinder the relationships between business and universities. Questions include:

- **Are there ways in which the financing arrangements in your country are particularly effective at promoting business-university collaboration?**

  Programs like the NSF GOALI initiative in the US can be quite effective in supporting "pre commercial" technology development. The EU funded Framework Program, in which we also participate, carries considerably higher "overhead" and bureaucratic inertia (see below).

- **If R&D tax credits have been introduced, have they influenced business demand for research and skills? If so, how? Are there other means to the same end?**

  Your covering letter describes the objective to "…review long-term links between business and the universities in the UK, with a view to seeing how they could be improved to the benefit of the economy as a whole". Governments can support R&D by business and university by R&D tax credits or by a system of grants. We have certain reservations about grants or subsidies that can be illustrated by consideration of the EU Framework Program that seeks to influence the direction of R&D and the formation of corporate links with universities. While the impact of the R&D grant system on the economy as a whole is hard to determine directly, conventional economic thinking suggests that a system that diminishes the role of the markets and is dependent on the ability of the funding agency to "pick winners" will not be as successful as a system where the market determines success. A return on investment in R&D by taxpayers, and benefit to the economy as a whole, is more likely under a system of R&D tax credits.

  The Economist magazine, in a February 27th article entitled "Finding Your Niche" describes a recent paper on economic development by 2 economists at Harvard university. They propose that "The discovery of poor countries' industrial strengths is a matter of trial and error" and conclude:

  "Neither economists nor emperors can be relied upon to pick winners. The best bet is entrepreneurial trial and error."

  and

  "Devising industrial policy, like divining comparative advantage, is a matter of trial and error. Many governments have tried; most have erred."

  We consider that a system of R&D tax credits improves the economy as a whole in the long-term more than a system of R&D grants or subsidies. Under a system of grants, companies and universities are less motivated to develop and commercialize technology quickly and profitably. A system of grants is expensive to administer and hence the benefit to the company's researchers is reduced by this administrative overhead. A system that reduces a company's tax would encourage multinational companies to invest in profit generating R&D in the UK and with UK universities, and would provide the government with a return on the investment in the R&D tax credit. We believe, however, that it is important to simplify the tax benefit as much as possible and to ensure that the tax benefit is actually spent on research; it is important to avoid the tendency for tax

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systems to be cumbersome and obscure. For this reason, there may be advantages to paying the tax credit as a tax refund directly to the research entity of a company, which could be a distinct legal entity. This would improve transparency for the system and ensure that the tax foregone by the government is transferred directly back into the research activities of the company.

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The review team welcomes written submissions by e-mail to lambert.review@hm-treasury.gov.uk or by post to The Lambert Review of Business-University Collaboration, 1 Horse Guards Road, London, SW1A 2HQ, UK by 17th April 2003. **Unless submissions are specifically marked as confidential, they may be posted on the review website** at www.lambertreview.org.uk (from mid February.) Please include the name and contact numbers of the person to contact for any follow-up discussions.

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