Yorkshire Forward and Yorkshire Universities Joint Lambert Response.

Introduction.

Yorkshire and Humber has a population of 4,964,838 (April 2001), equivalent to 8.45% of the UK population. In 1999 regional GDP was £57.5bn, (7.4% of the UK total). In terms of GDP per head Yorkshire and Humber is one of the poorer regions with only the North West, North East and Wales having a lower figure.

Yorkshire and Humber has an extremely strong research base with over £240m (1999) spent on research and development in the region's 8 research active universities, one of the highest levels in the UK. However, annual business R&D at £300m (1999) is joint lowest in the UK, and is less than 40% of the UK average. The region is also the recipient of lowest Government investment in R&D outside of the universities.

It is therefore clear that not only does the university sector plays an unusually large part in the region's science base, but that it needs to be better connected to the region's industrial base.

The science base for the Yorkshire and Humber region is an important asset for economic development, with the potential to provide knowledge, skills and technology to help drive growth and open up new opportunities for the region and its people. Yorkshire Forward is working in partnership with key regional stakeholders and delivery organisations to facilitate and support the development and exploitation of the regional science base as prioritised in the Regional Economic Strategy (RES). The RES places emphasis on growing the region's businesses in five key Clusters and "puts the region's universities at the heart of economic development". R&D and technology transfer from the region's universities to businesses to encourage innovation is a prime objective of the RES. The RES also prioritises the enterprise agenda with particular focus on spinouts from the Higher Education sector.

Questions for Consultation

1) Best practice and examples of excellence in business-university collaboration in the UK and abroad.

There are many examples of excellence in university-business collaborations within our region, the specific details of which can found in the responses from the individual regional HEIs.

The following summarises general observations that can be made about these university-industry interactions, illustrated with some of the more regionally important examples.

It is generally easier for the larger organisations to identify and thus collaborate with the university sector because they have the resources (human, time and financial) to allow this to occur more efficiently and effectively.

Smaller companies will generally interact with universities via the various financially assisted schemes that are available (SMART, TCS, CRAFT, or ERDF funding), as this significantly reduces the financial risks to the SME. From a recent investigation into the linkages between the science base and regional industry, many long-standing collaborations occur because there is the right "chemistry" between the academic and industrial partners i.e., they have done a good job in the past and therefore will be used again. However, the mechanism whereby an SME finds an appropriate academic to work with appears to be rather haphazard, and is very much based on previous experiences, or linkages through the above schemes. In some cases, these collaborations are occurring at a relatively informal level, as the bureaucracy involved in using the "formal" channels can be a disincentive.

The following are excellent examples of long-term business-university collaborations that are currently or anticipated to bring long term benefits not only to the parties involved, but also to the regions as a whole.

Bradford Particle Design.

Bradford Particle Design (BPD), now known as Nektar Therapeutics, is the most successful UK university spinout, being sold to US company Inhale Therapeutics Systems for $200m in 2001. The origins of BPD lie in Bradford's School of Pharmacy, which has a history of interacting successfully with most of the large pharmaceutical companies. The main industrial collaboration in the case of BPD was with GlaxoSmithKline, who were involved at a very early stage and funded a Ph. D student to look at the way that supercritical fluid technology could be used to control particle formation, for more effective formulation and delivery of drugs. The technologies developed within the Drug Delivery Group within the School of Pharmacy led to the creation of BPD in 1994, and via its collaborations with a number of global pharmaceutical companies, it became a world leader in the controlled production of powders for medicines.

The critical success factors in the collaboration that led to the creation and development of BPD were:

- Robustness of the technology (concept and protection)
- Close industrial interaction
- Retaining a close relationship with the academic origins within the School of Pharmacy
- Placement programmes and joint research
- A strong industry focused management team.

Advanced Manufacturing Research Centre

The Advanced Manufacturing Research Centre (AMRC) with Boeing at the University of Sheffield is another excellent example of how research excellence and the correct industrial approach can not only facilitate long-term relationships, but also lead to the creation of research structures from which other regional industry can benefit.

It was the research excellence in metals and machining that initially attracted Boeing to collaborate with the University of Sheffield and this ultimately led to the creation of the AMRC. Companies pay a joining fee that gives them access to the results of generic research carried out on behalf of client companies. IPR remains with the AMRC but member companies have an exploitation window in which to gain competitive advantage before the University publishes the results of its research. Membership is open to any company. The people exchange of staff between the AMRC and industrial and academic partners in other countries is a feature of the Centre.

The AMRC is also key component of Yorkshire Forward's cluster activity and a catalyst for an Advanced Manufacturing Park in South Yorkshire. Though the science developed within the AMRC is internationally acclaimed, there is no doubt that a major reason for its success in working in partnership with business is the appointment of a Commercial Director. The Commercial Director speaks the language of business and ensures the AMRC works to industrial timescales. This is a model that Yorkshire Forward has actively encouraged and one being pursued through the highly innovative "Centres of Industrial Collaboration" project (described later).

Critical success factors in the collaboration with Boeing and the creation of the AMRC are:

- Clear rules on the ownership and exploitation of IPR
- Business focused approach
- Cutting edge industry relevant research excellence

Micro Chemical Systems

This is an excellent example of the creation of a spinout company that is a joint venture with industry. Micro Chemical Systems (MCS) is a joint venture with GlaxoSmithKline, which is based on a number of patents held by the University of Hull with finance from GlaxoSmithKline. MCS is a world leader in the development of glass-based micro-reactors that will have many applications in sensors, production of specialist chemicals and diagnostics.

Critical success factors in the collaboration with GlaxoSmithKline were:

- Clear rules on the ownership and exploitation of IPR
- Business focused approach
- Cutting edge industry relevant research excellence

The Science City York

The Science City York initiative was launched in 1998 as a result of an Ernst and Young study which identified three knowledge-based clusters in York– Bioscience and Healthcare, Information and Communications Technology and Arts and Heritage Technology.

It is a distinctive partnership led by the University and the City of York Council closely working with private enterprise with the goal of fostering and harnessing York's world-class research base to underpin the creation and growth of competitive, successful businesses. Science City York therefore works to a business driven agenda and is at the heart of the local economy.

Science City works to place science and technology jobs at the heart of the local economy and during its first four years of operation created over 1,800 new jobs and 30 new businesses bringing the total or science and technology related jobs in the York area to 9,000 science and technology. The initiative aims to create 15,000 extra high technology jobs by 2021.

The main success factors that lead to the success of Science City York are:

- The drive and vision of both the university and City council
- The move to York of Smith and Nephew's global research centre, and the engagement with both the local economy and the university
- The Business support mechanisms that are in place to support the creation of new high technology businesses. Yorkshire Forward has recently invested £2m to help create the York Bio-incubator.
- Engagement with the private sector.

It is clear from the few examples described above that the critical success factors are very similar. It is also clear that it tends to be the larger companies that will more readily engage through IPR and/or joint venturing routes, which may be daunting to the SME community.

2) How to strengthen such relationships, what are the main barriers to doing so?

Managing and Valuing IPR.

Industry often complains that universities place unrealistic commercial values on their IPR, and this can be a significant barrier for business, especially SMEs, to exploit our science base. Universities tend to over value their IPR as they seem not to value their IPR based on the fact that it will invariably require several years of further development and substantial industrial investment before the product finally comes to market. The area of IPR evaluation has been enhanced over the last few years through the development of third leg activities and HEIF funding, however it is still an area for concern

Successful IPR evaluation and commercialisation are very dependent on the skills, experience and networks of the individuals involved in this process. Historically those that have been employed to manage university IPR portfolios have not had the necessary skill sets to be truly effective in theses roles. Although these individuals were often qualified to MBA level, they did not necessarily have the breadth of market contacts to maximise the exploitation of the IPR.

One way that this is being addressed at Leeds University is by the development of a long-term agreement with Axiomlab, a private sector organisation whose core competence and service offering is to assist universities to commercialise their intellectual property. This interaction is currently at a very early stage and it is too early to judge its success. However, if successful this could become a model that other Universities may wish to follow.

Yorkshire Forward have also recognised this area of weakness and thorough its Centres of Industrial Collaboration programme and will be appointing Commercial Managers, recruited from industry, to manage the interactions between university departments and industry. One of the roles of these Managers will be to manage expectations between universities and industry as to the value of IPR with a view to maximising technology transfer to industry.

Spinouts

Universities want to retain a controlling interest in spin-out companies, but investors (and most truly entrepreneurial academics) want to see more independence. Universities argue that they should be allowed to retain a large share of a spin-out as their stake is diluted at every stage of investment. Why should they lose out when it is "their research funding" that has resulted in a spinout? However, most commercially successful spin-outs appear to occur where the university does not hold a controlling share.

Many university spinout companies invariably have poor commercial management. True entrepreneurs brought in to assist spinout companies are often dismayed by the lack of commercial ambition and drive - academics usually have other drivers. In MIT for example, the technology element of spinout companies is often regarded as a “given”, and successful companies gather together strong management teams that have the appropriate credibility and strong linkages with both the financial and business communities. This is an area that needs to be further developed if we are to create companies that can compete in an international field.

Yorkshire Forward is funding the CONNECT Yorkshire scheme to accelerate the creation of high technology spin-out companies. CONNECT matches academics and technologists with professional service providers, financiers, lawyers and entrepreneurs to accelerate the push of leading edge technology across the region. Connect Yorkshire achieves this by increasing the availability and access to experts and advice, helps with securing funding for development and provides greater access to research and development. CONNECT also operates a FastForward system, where potential

entrepreneurs are "groomed" by a panel of expert individuals drawn from the above organisations for investment readiness Over the past 2 years CONNECT has helped 50 individuals to grow their businesses and 9 have benefited from assistance under the FastForward system.

One of the barriers that university spin-out companies face in terms of obtaining financial support for R&D and innovation are the rules that define an SME. University spinouts are generally majority owned (at least 25%) by the parent university and this disadvantages them in terms of qualifying for national and European R&D and innovation support as the definition of an SME is that it must not be more than 25% owned by more than one enterprise which are not themselves SMEs. Relaxing or changing this definition of an SME would certainly have a large impact on the ability of university-based spinouts to attract additional funding and support for innovation.

Spinout companies are now an important route for technology transfer to industry, especially the larger corporate organisations. With the reduction in corporate R&D laboratories and the realisation by industry that is cannot be expert in all scientific fields, the role of the university sector has grown in importance. University spinouts play an especially important role in this as they "condition" the initial scientific patents into technology solutions that are much closer to the market place. This transition effectively reduces some of the risks associated with acquiring the initial scientific patent, thus making the technology more attractive to industry. Many large corporates now actively engage in "technology shopping" via university spinouts as a means of identifying new technologies. Our region has an excellent example of "technology conditioning" and "technology shopping" with the creation and subsequent sale of Bradford Particle Design for $200m in 2001 (described above).

Culture and Recognition

Cultural differences and misconceptions still exist between industry and universities and these reduce the effectiveness of industry-university engagement. Industry often has a lack of awareness of university activities and of their ability to provide solutions in the short timescales often demanded by SMEs. Universities, particularly the more research intensive ones, see more value in attracting the large contracts from the large corporates rather than pursuing many smaller contracts with regional companies. There may also be a lack of appreciation that a lot of company enquiries may often be answered by a minor time commitment of an academic. The importance of timescales is key to the interaction of industry with universities, particularly SMEs who generally operate on tighter timescales than larger organisations. Regional and national programmes could be put in place to breakdown cultural barriers, and gain greater mutual undetstanding, such as the very successful "Open For Business" event that was held by Hull University to market their offerings to local industry.

There is also the issue of misalignment between the priorities of industry (to make money) and the universities (teaching, research and publications). This mutual

misunderstanding can cause reluctance to engage, or the outcomes not to be mutually beneficial.

This tension between teaching, research and "reach out" (interacting with industry) is certainly stronger in the traditional research-intensive universities and less so in the less research intensive new universities that traditionally hve a track record in interacting with regional industry. Third-leg reach out activity must be given the same recognition nationally as excellence in teaching and research, and appropriate rewards must be in place to encourage the academics to proactively undertake this type of activity.

Regional Initiatives to address the main barriers that prevent universities and industry collaboration.

In 2002 Yorkshire Forward conducted a review of the region's science base that included an assessment of the extent and quality of linkages between regional industry and the science base, predominantly the universities.

The review found weaknesses in university/industry links in terms of:

- **Accessibility**: large corporates generally have the resources and previous contacts to trawl the universities to identify the appropriate expertise, and to understand the mechanisms to access this expertise. However, for an SME with limited resources, finding the appropriate expertise from within our 8 regional universities is a difficult process (who to see and how to access them)
- **Mutual understanding**: this is the age-old problem of the universities and industry talking different languages (business vs. academic), differences in priorities (research papers vs. technology to solve problems and make money) and differences in timescales between the responsiveness of universities against the needs of industry. .
- **Administrative effectiveness**: slow bureaucratic process, e.g., contracting, IPR
- **Benefits**: many businesse do not fully understand how the region's science base can benefit them.

It was concluded that these issues could be main contributing factors in the underperformance of our region in relation to business Research and Development relative to other UK regions (highlighted in the introduction).

Centres of Industrial Collaboration

To address these issues, Yorkshire Forward is commissioning up to 15 Centres of Industrial Collaboration (CIC), phased at approximately 5 per year over the next three years. These Centres, which will be set up strictly on a commercial basis, will seek to address the key deficiencies identified above, as they will act as the focal point for science/industry interactions. The Centres will each have a Commercial Manager, recruited from the appropriate industry, who will ensure industry/university interaction is as mutually beneficial as possible and that long-term relationships are developed between these Centres and the region's industrial base. The business focus of the Commercial

Managers and the Centres will be critical to the success of this programme and Yorkshire Forward is taking great care to ensure that this business focus is integral to and embedded in these Centres.

Science Network Brokers.

To address the question of regional industry not understanding how universities can benefit them, a team of Science Network Brokers is being recruited whose role will be to forge linkages between industry and academia. These individuals will be recruited from industry, and will have strong research backgrounds, that will be used to facilitate engagement between Yorkshire Forward's Clusters and the university base.

Knowledge RICH

Knowledge RICH is a part EU funded project to provide regional businesses with easy and free access to information on science, technology and innovation. Three of the main elements that relate to universities and regional industry are:

- Technological Observatory: an over the horizon look at market trends, technological developments and impending legislation, that present opportunities and threats to our region's industrial base. This information will allow industry to be better prepared and to identify the appropriate technologies and skills to meet these challenges.
- Regional Expertise Database: Regional experts in science, engineering, technology and innovation, who are willing to interact with industry and share their expertise, will register on this database. This will address many of the problems associated with SMEs not being able to easily identify the appropriate academic within the university sector.
- Opportunities bank: This is a "shop window" for latent IPR and technological facilities that can be made available to regional industry. Again this will address many of the issues of SMEs not being able to easily identify the appropriate resources within the university sector.

3) How can business attract the best graduates and postgraduates with the skills they require, especially in technology?

Business leaders recognise that new graduates are essentially "raw recruits" and the very best will still spend their first year in industry learning to put theory into practice. This situation may be acceptable to the larger companies who have the resources for training to happen, but SMEs with fewer resources want graduates that come already armed with some business related skills.

It is much less clear how industry interacts with the HEI sector to influence curriculum development. Generally communicating business need for particular graduate skills seems to fall to the larger companies, and influence can be brought by for example the sponsorship of certain courses e.g. BMW sponsored a postgraduate diploma/MA in Corporate Affairs and Communication with Trinity and All Saints College in Leeds.

The situation regarding smaller companies is less clear, and although there are regional examples where small companies have influenced curriculum development (found within individual responses) there do not appear to be any effective formal mechanisms (or if they are there, they are not widely known) to allow them to communicate their needs for specific skills or for types of graduates. One reason why SMEs are generally less successful at communicating their needs is that they lack the critical mass to get their voice heard, and they often will not have the resources individually to sponsor courses. Structures should be put in place to allow the better communication of SME sector needs, and possibly funding to assist with curriculum development.

It is also probably fair to suggest that it is the post 1992, less research-intensive institutions or colleges associated with universities that are more successful at interacting at a local/regional level to develop courses to meet local needs. The main reason that these institutions are more successful in this respect is that traditionally they have had a longer history of interactions with local industry than the more research intensive HEIs, whose horizons have tended to be more global.
An excellent example of a regional company collaborating with a regional university to develop courses to deliver graduates with the skills it needs is Attik. Attik is a global design company, originally formed by two local Huddersfield entrepreneurs with a Prince's Trust grant. The headquarters of Attik are still in Huddersfield. The two founders are passionate about supporting regional and local issues and approached Huddersfield University with a proposal to co-run an MA in Creative Imaging. This was driven partly by their knowledge of industry need to recruit graduates with corporate experience but also an awareness of the existing strengths that Huddersfield University had in the design sector - historically in textile design.

The crucial factor in the success of the relationship is that both Attik and the university contribute to and benefit from the relationship. Attik bring a recognised well-respected corporate brand to the project, industry experience and real clients, with Huddersfield University bringing the structure and pedagogy. Attik benefit from exposure to post graduate talent from around the world and their association with a university - Huddersfield receive industry guidance and a higher industry profile worldwide through Attik contacts in Australia, USA and the UK.

In some sectors, there appears to be a mismatch between the supply and demand for certain skills. For example within our region, the HEIs are very successfully producing high quality chemistry graduates, but industry has a shortage of people with skills at the technician level, which can be better met by the Further Education infrastructure. It must be remembered that although the Further Education sector does not educate people to the same level as the HEI sector, it does play a very important and often forgotten role in producing people with the skills that particularly local/regional industry requires.

Schemes such as TCS and CASE are also vehicles to allow companies to interact with universities to attract graduates, and this route can allow long-term relationships to occur that leads to more collaboration and potentially further uptake of graduates.

In summary, there needs to be better mechanisms in place to allow the dialogue between industry and universities to occur to ensure that graduates with the correct skills are produced.

There is however a more fundamental question that needs to be addressed in terms of supplying graduates with the appropriate skills and this is how to attract the best to areas such as maths and physics where there are significant current and projected shortages. These shortages are not only due to shortages of graduates, but also in the provision of teachers with the necessary skill sets deliver the subjects and inspire the young people to enter these areas. This is an area of great concern and one that has been highlighted in the recent Robert's Review. The whole area of a career in science needs to given high priority from early school experiences through to higher education. One of the main barriers here is the career expectation of those choosing science subjects and the value that society as a whole places on science, engineering and technology graduates.

For example, many numerate graduates are attracted away from their chosen discipline because the career rewards in for example accountancy are greater than in for example chemistry. Many industry jobs are seen as "dirty", whereas the office based management jobs are "clean". The image of working in science in industry needs to be changed, if the right calibre of graduates are to be attracted and retained. Financial incentives should also be pursued to selectively address shortages, e.g., writing off of student loans, reduction in tuition fees for certain subjects etc.

4) Do financial considerations currently help or hinder the relationship between business and universities.

R&D tax credits
Our research has shown that R&D tax credits are not being exploited by regional SMEs, to any significant degree, and there are several reasons for this

- There is low awareness amongst SMEs of how R&D tax credits can help them
- There is a perception that the process may be complex
- Many SMEs do not think that they can benefit from R&D tax credits because
    - they do not adequately account for the R&D that they carry out,
    - they do not think that what they do is R&D.
- R&D grants reduce the risk of innovation more than R&D tax credits
    - Before a company receives an R&D grant an application is appraised and approved or rejected. If rejected a company can choose not to pursue that particular line of research, but if accepted, the company has a substantial proportion of the financial burden removed.
    - With R&D tax-credits, potential financial rewards may be similar to a government grant scheme, but the burden of risk remains firmly with the company during the R&D phase. Decisions on whether a project is eligible are often finely balanced, so a company would benefit from receiving an

up-front assurance from the Inland Revenue that a particular R&D project qualified for R&D task credit.

The recent budget announcement to reduce the minimum expenditure to £10,000, should also have a positive benefit in terms of stimulating demand for R&D tax credits.

University spinouts.

As stated above spinouts from universities are frequently disadvantaged with regard to accessing public funding for innovation due to the majority stakeholding of the host university. This disadvange could be overcome by either:

1. HEIs finding more effective and creative ways of allocating and holding equity, so that the spinouts become eligible for this funding.
2. Changes to the SME definition that would allow universities to establish start-up companies with a majority shareholding that are still eligible for SME funding e.g. SMART, CRAFT etc.

European Framework 6 Programmes.

European Framework 6 funding is a very important mechanism for both promoting collaboration between industry and universities and enabling technology development and transfer to industry. Although there are large sums available, it has become increasingly difficult for SMEs to participate due to the costs and time associated with developing an eligible submission for the European Commission. To address the issue, Yorkshire Forward has initiated a financial package called the Preparatory Award that helps to offset the costs of finding transnational partners and knowledge providers, conducting IPR searches, or drafting the proposal. It is expected that this will stimulate regional SMEs to be more successful in participating in R&D, and hence in the development of long-term HEI collaborations.

Yorkshire Forward is also providing assistance to the region's universities to find industrial partners in the development of framework 6 Integrated Project applications. Pera, who have access to the Eurexel network of industrial and academic R&D partners throughout Europe, have been contracted to identify the industrial partners for the Integrated Projects consortium This initiative will enable regional universities to find and subsequently work collaboratively with industrial partners that they would not normally have found.