

Research and Innovation - View of Universities

David Livesey
Secretary-General League of European Research Universities

The place and role of (research intensive) universities in innovation

In this presentation I will argue that:

- diversity is a key feature of higher education systems which generate innovation
- innovative knowledge informs business innovation in a diversity of ways
- innovation requires effective (formal or informal) networks for knowledge transmission
- formal partnerships must be entered into by all parties to their mutual benefit
- innovation should not deflect organisations from their fundamental contributions to society
- universities' engagement in the innovation process relates to five specific modes of business transformation

diversity is a key feature of higher education systems which generate innovation

- diversity is often cited as good but strongly resisted when it appears to favour research intensive universities over the rest of higher education spectrum
- from the perspective of business - contribution of higher education is not a linear combination of teaching and research – as I will later demonstrate
- innovation results from active learning
- active learning combines learning and new knowledge acquisition
- teaching and research are joint products of active learning
- it is the nature of the contribution of the active learning produced which commonly distinguishes teaching from research

Important caveats about the role of universities

Boulton & Lucas. *What are universities?* LERU (September 2008)

“It is our contention that **slipshod thinking about the roles that universities can play in society** is leading to demands that they cannot satisfy, whilst obscuring their most important contributions to society, and, in the process, undermining their potential.”

“It is important to remember that the space of university endeavour is essentially one where **discoveries cannot be determined in advance** and where the consequences of the encounter between minds, between a mind, a problem and evidence, and between the minds of successive different generations are profoundly and marvellously unpredictable. They are the very conditions of creativity.”

“**It is crucial that the true role of universities in modern societies and the relationships between means and ends are understood before mechanisms to promote change are put in place.**”

Other's perspective - observations

“Europe needs universities able to build on their own strengths and **differentiate** their activities on the basis of these strengths. Not all institutions need the same balance between education and research, the same approach to research and research training, or the same mix of services and academic disciplines. Research, although remaining a key task of the systems as a whole, is not **necessarily a task for all.**” EU Commission Communication 'Delivering on the modernisation agenda for universities: education, research and innovation' COM (2006).

“While in the EU about 2000 universities are also engaged in research and deliver postgraduate diplomas leading to Master and Ph.D. degrees, in the US, out of 4000 higher education institutions, only 500 deliver postgraduate education and only 150 universities are research universities.” Van der Ploeg and Veugelers, (2007) *Higher Education Reform and the Renewed Lisbon Strategy: Role of Member States and the European Commission* CESIFO Working Paper No. 1901

Other's perspective – Bruegel prescriptions

“Doctoral training should be a central focus for the channelling of new public resources directed towards higher education, and the indispensable critical mass will only be reached if these new resources are targeted very selectively.”

“It is likely that the need to compete for research grants, as well as for students and faculty, will induce specialisation and it is not impossible that many universities will end up being excellent at something. The ‘excellent’ universities will then be those that manage to be excellent at many things. By definition, there will not be many of those.”

Higher Aspirations: An agenda for reforming European universities Bruegel Blueprint 5 July 2008

LERU's perspective - higher education and research are the vital ingredients for innovation

“Higher education and research are vital ingredients in the European response to the increasingly open and competitive global economy and the shift to high value production based on information and knowledge. The quality of both must be of the highest international standard, the university system needs to be diverse to respond to the great diversity of demands upon it, and the innovation processes that exploit new knowledge and highly trained people must be efficient and effective. With notable exceptions and national variations, Europe must be judged as deficient in all three areas. These deficiencies must be remedied as a matter of urgency.” *Universities and Innovation: The Challenge for Europe* LERU (November 2006)

innovative knowledge informs business innovation in a diversity

- innovation depends upon the critical learning capacities (skills) of all participants
- brilliant music requires both accomplished performers and listeners
- without listeners musicians play in vain
- without critical readers publications have no value
- innovative business has its critical readers and accomplished listeners which is why it is innovative

The concern must not only be with what is learned, but also with how it is learned

“Generation by generation universities serve to make students think. They do so by feeding and training their instinct to understand and seek meaning. They are taught to question interpretations that are given to them, to reduce the chaos of information to the order of an analytical argument and to seek out what is relevant to the resolution of a problem. They learn progressively to identify problems for themselves and to resolve them by rational argument supported by evidence: and they learn not to be dismayed by complexity but to be capable and daring in unravelling it. They learn to seek the true meaning of things, to distinguish between the true and the merely seemingly true and to verify for themselves what is stable in that very unstable compound that often passes for knowledge. They are the qualities that every society needs in its citizens, and ones that universities should seek to reinvigorate.”

Boulton & Lucas *Research Europe* (18 September 2008)

Engaging reflective individuals with their institutions

- Universities are full of thousands of reflective individuals but universities are not reflective institutions particularly about the production processes for teaching and research.
- The future of universities crucial depends upon those reflective individuals engaging with their institutions to ensure that they are wise about what they do and how they do it and that they effectively communicate the complexity and value of higher education to society at large.
- LERU is actively seeking:
 - to deepen the dialogue about the evolving yet fundamental characteristics of the Ph.D.;
 - to understand what research based teaching means when teachers in research intensive universities say that their teaching is informed by their research; and,
 - to develop taxonomy frameworks in which the rich tapestry of higher education can be described.

The rationale of the business community for their relationship with universities

“Technology is vital to BP’s business strategy. It underpins the search for oil and gas. It stimulates innovation. Through it we can make more efficient use of the resources we have already found. It helps to create new chemicals and find new sources of energy, and makes it easier to control costs, safeguard the environment and improve safety. Our activity is focused on improving quality and reducing the cost of our products, as well as giving us access to new reserves of oil and gas. Much of our work is done in partnership with outside organisations. One link, with the University of Cambridge, aims to improve the fundamental science that supports our industry. **We drive technology forward through our business...**” *BP Annual Report for the year 2000.*

Examples of BP's use of research output at stages ranging from product development to basic research

Product	Oil	Oil
Product development	Lead replacement petrol	Safeguard the environment
Research & Development	Steerable well heads	More efficient use of the resources
Applied research	3-D seismic data	New reserves of oil
Basic research	Multiphase flow	University of Cambridge

Although the partnership with “the University of Cambridge” is basic research focused on fundamental problems in multiphase flow, it is quite clear that in a diverse higher education sector there will be institutions which, because they are not research intensive universities, have missions that enable them to engage in helping the business community drive technology forward through their business whether it is for product development, R&D or applied research.

BP Pledges \$500 Million for Energy Biosciences Institute and Plans New Business to Exploit Research

“As part of its continuing drive to find longer term commercial alternatives to oil and gas, BP is to fund radical research aimed at probing the emerging secrets of bioscience and applying them to the production of new and cleaner energy, principally fuels for road transport. The company plans to spend \$500 million over the next ten years to establish a dedicated biosciences energy research laboratory attached to a major academic centre in the US or UK, the first facility of its kind in the world.” BP Press Release, 14 June 2006

After considering several world-class research universities, including some in Europe, BP chose the University of California Berkeley, the University of Illinois and the Lawrence Berkeley National Laboratory to join in this \$500 million research programme.

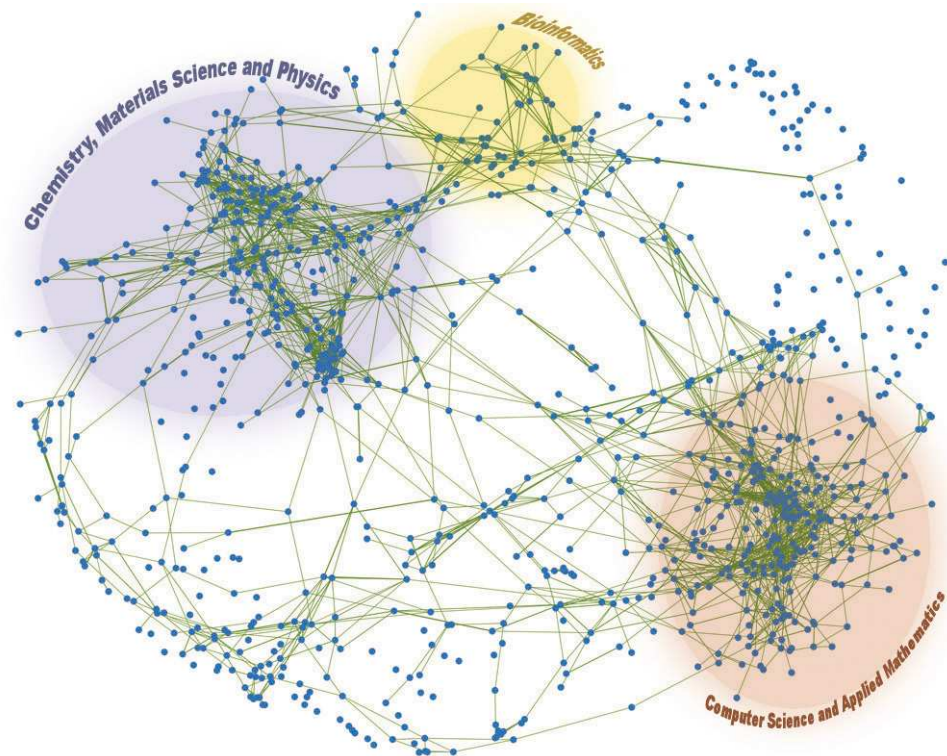
The Energy Biosciences Institute performs ground-breaking research aimed at the production of new and cleaner energy which many wish to see at the centre of the European Research agenda.

We all need to understand the basis on which such decisions are made by the business community and what research environment universities need to provide if Europe is to win such bids in the future.

Linking the business community with a university in a network

- Universities are loosely knit clusters of highly reflective individuals within a single legal entity which lacks the coherent strategy and the line management accountabilities common in the business community
- Academics see business organisations as monoliths so their speaking to one corporate representative serves for their speaking to the whole organisation.
“If only we knew what we know at HP” Lew Platt, former Chairman of Hewlett Packard
- So precisely did Lew Platt put his finger on an important organisational point that this quotation has also been attributed to the leaders of other major corporate organisations.
- In all organisations understanding of the business process and the capacity to innovate is vested in individuals from whom and with whom effective communication is the key to organisational success.

innovation requires effective (formal or informal) networks for knowledge transmission



Taken from http://informatics.indiana.edu/rocha/figures/IPP_3_clusters_labels.jpg

Building a network of knowledge communities

- Knowledge is an input and an output to the processes of both teaching and research.
“our teaching is informed by our research”
- Neither process is independent of knowledge creation elsewhere both within other universities and also in the business community since it a producer, as well as a consumer, of knowledge, of understanding of processes and of innovation.
“if only Stanford knew what Stanford knows” if only HP knew what Stanford knows” if only Stanford knew what HP knows” if only Stanford knew what Cambridge knows” if only Cambridge knew what Stanford knows” “if only Cambridge knew what HP knows”
- Contested excellence is the key to the achievement of effective and efficient high quality outcomes
- All organisations have to strike the right balance between collaboration and competition.

formal partnerships must be entered into by all parties to their mutual benefit

Effective partnerships between universities and the business community are those which:

- are freely entered into by both parties to their mutual benefit
- reflect the centrality of teaching and research to universities' contributions to society
- respect the rationale of the business community for their relationship with universities
- link the business community with a university in a network
- serve specific modes of business transformation.
- provide a diversity of university types
- do not overemphasise IP
- use good practice in negotiating structured partnerships
- are clear about their public benefits

Lessons from university partnerships with the business community the Dutch experience

- increasing importance to both parties:
 - companies less able to develop all the knowledge they need for innovation on their own
 - universities aim to promote the common interest by means of cooperation with companies and consequently,
 - both improve and deepen each other's own knowledge development.
- every type of cooperation is unique but there are a small number of procedural matters common to successful agreement being arrived at swiftly
- benefits are asymmetry and chiefly in contributions to the local, regional or national economy and appear not to generate very much extra net income for the university
- preconditions for good collaboration:
 - trust and understanding of each other's interest's
 - knowledge of the scientific and industrial and IP context for the collaboration
 - mutual interest of the parties in the added value of projects carried out

Lessons from university partnerships with the business community the UK experience

- system is working well but addressing some important problems would increase the number of successful deals and the speed with which they were made.
 - overemphasis on IP on the part of both universities and businesses - guilty on occasions of putting excessive emphasis on ensuring their own ideal outcome from the negotiation in relation to IP, when it is often not even the most important aspect of the research collaboration.
 - unclear messages coming both from Government and public funders e.g. confusion on primary aim of collaborative research and public research funders expectation about IP
 - need for good practice in negotiating process i.e. understanding the motivations of the other party and having appropriate escalation procedures. Whilst some of these are commonly recognised practices that are self-evidently sensible, it is clear that they are often not followed

First thoughts

- Politicians are gripped by a belief that the economic future is crucially dependent upon universities engaged in world class research. The reality is that Europe needs a widely differentiated and diversified higher education system comprising world-renowned research institutions next to networks of excellent national and regional universities, which also provide shorter technical education, with parity of esteem between those achieving excellence in what they choose to do.
- The challenge for higher education is to achieve the parity of esteem which exists between excellent opera singers and tragic actors.
- We must not underestimate the ability of small incentives to significantly alter the behaviour of universities

Universities and Innovation: recognition of engagement by universities in innovation process

- By universities in Europe over the last decade as part of their mission and through their clearer definition of their actual and potential roles.
- That universities are important businesses in their own right, realising the highest levels of financial return on public investment, and making a significant contribution to GDP and national employment.
- That the route from discovery to patenting and licensing is not necessarily their most important contribution to innovation. But,
- That more complex relationships involving the recruitment by industry of PhDs and researchers, exploitation of codified knowledge, joint problem-solving enterprises, and the use of the university as a public space together make a more influential contribution.

universities' engagement in the innovation process relates to five specific modes of business transformation

The university contribution relates to five specific modes of business transformation:

- the creation of knowledge economy nodes;
- the creation of indigenous new businesses;
- transplantation from elsewhere;
- diversification into technologically-related businesses; and
- enhancement of existing businesses.

LERU's perspective – the need for a better understanding of diversity

- The engagement by universities in innovation process relates to the following five specific modes of business transformation, not all of which fall within the mission of research intensive universities: indigenous new business creation; creation of knowledge economy clusters; transplantation from elsewhere; diversification into technologically-related businesses; and, enhancing existing businesses
- Accordingly these business transformations require a diversity of university types, from research intensive universities contributing at the forefront of the international research agenda, to universities that engage strongly with specific regional and local needs for manpower, skills and research. LERU regards it as a priority to achieve a better understanding of this diversity and has embarked on gathering a set of exemplars to illustrate the breadth and suggest a taxonomy for the spectrum of higher education.

Universities and Innovation: diversity of transformations requires a diversity of university types

- The diversity of transformations requires a diversity of university. The examples given cite universities which are research intensive institutions. We all need to focus our effort on identifying and celebrating other contributions of the higher education system.
- Politicians are gripped by a belief that the economic future is crucially dependent upon universities engaged in world class research. The reality is that Europe needs a widely differentiated and diversified higher education system comprising world-renowned research institutions next to networks of excellent national and regional universities, which also provide shorter technical education, with parity of esteem between those achieving excellence in what they choose to do. The challenge for higher education is to achieve the parity of esteem which exists between excellent opera singers and tragic actors.

Box 1 – Example of indigenous new industry created from university research

- It involves the creation of an industry that has little or no precursor in the region based on exploitation of university-developed technologies that strike a market chord.
- **Gambro hemodialysis** The pioneering work of Prof. Nils Alwall at **Lund University** was the basis for a sustainable and affordable dialysis therapy. The company Gambro was founded to develop and market an artificial kidney, based on Alwall's research. Gambro now has more than 11,000 employees in some 40 countries and in 2005 achieved revenues of \$2.0 billion (US). The business is divided between areas: Gambro Renal Products, Gambro Healthcare and Gambro Blood Component Technology.

Box 2 - Example of knowledge economy nodes around a university

- It involves clustering of knowledge-intensive companies in the vicinity of a university with a powerful, internationally competitive research capacity. This is by now a familiar, perhaps too familiar phenomenon since it overshadows the other possible modes of transformation.
- The Leuven Cluster and the Cambridge Network are very well known but there are many others of significant scale including those around Edinburgh and Utrecht universities. In every case recent developments have focussed on activities which stimulate innovation and entrepreneurship within and beyond the nodal university and provide supporting infrastructure of a wide variety of kinds for engagements not only with the local community but national and international business organisations.

Examples of supporting infrastructure for knowledge economy nodes around a university

- **Cambridge Integrated Knowledge Centre (www.cikc.co.uk)**: brings together research activities in molecular and macromolecular materials from different departments including the Judge Business School to create innovative knowledge exchange activities spanning business research, training and specific exploitation.
- **Cambridge Enterprise Ltd (www.enterprise.cam.ac.uk)**: is a wholly owned subsidiary of the University responsible for commercialisation arrangements for University discoveries. It combines technology transfer services, consultancy services, and seed funds / new venture services.
- **Institute for Manufacturing (www.ifm.eng.cam.ac.uk)**: brings together expertise in management, economics and technology to address the full spectrum of industrial issues to help companies of all sizes to apply research-based improvement techniques via a programme of education and consultancy services.

Examples of supporting infrastructure for knowledge economy nodes around a university

- **University Enterprise Network** (<http://www.enterprisenetwork.group.cam.ac.uk/>): helps link entrepreneurship and innovation activities across the University by supporting the flow of information to students and staff about the wide range of entrepreneurship and innovation activities available to help raise awareness, develop skills, and provide direct advice and support.
- **Cambridge Technopole Group** (www.cambridgetechnopole.org.uk): is an network of business support organisations operating in the Greater Cambridge sub-region. Its aims are: to encourage the flow of information on new projects and initiatives between the members of the Group; to identify the key organisations involved in business support in the Greater Cambridge sub-region for the purposes of accurately signposting business customers; to publicise and explain the origins and growth of the 'Cambridge Phenomenon' in order to attract and retain appropriate new businesses to the sub-region and; to identify gaps in the provision of support for businesses, and to lobby for resources to fill such gaps.

Examples of supporting infrastructure for knowledge economy nodes around a university

- UCL Advances unites providers of investment, commercial and technical expertise to create successful enterprises. By combining the latest developments in the research arena with both capital and commercial know-how, they help businesses to thrive in today's economy.
- UCL Advances based on three types of expertise:
 - Opportunity Expertise "What problems need solving and what commercial needs must be met?"
 - Solution Expertise "How can research innovations be harnessed to solve important problems?"
 - Execution Expertise "How can innovations be brought to the marketplace?"
- UCL Advances bridges and extends existing networks between these communities to identify future societal and market challenges, leverage research innovations and ultimately deliver innovative solutions

Box 3 – Example of transplantation from elsewhere

- It involves the relocation of a company's activity because of its manpower needs, regional internal investment policies or increased proximity to important markets. Such transplants can develop into the core of a knowledge economy node as in Box 2.
- **Biovitrum AB** has relocated its research and development department to the Karolinska Institutet Science Park in 2008 to enhance the possibilities for both organisations to collaborate on medical research. Initially Biovitrum moved its Stockholm-based research and development operations and its management offices to Karolinska Institutet with the intention of eventually having all its research and development carried out at the university campus. Over the past five years, Karolinska Institutet, the Royal Institute of Technology (KTH) and Stockholm University have been running a joint project, called Stockholm BioScience, in the North Station area to create an internationally attractive environment of multidisciplinary research centres and biotech companies.

Box 4 – Example of diversification into technologically-related industries

- Existing business in a region goes into decline, but its core technologies are re-deployed and lead to the emergence of new businesses.
- **Industrial regeneration of North Milan** In response to the closure of the largest factories in the North Milan area in the early 90s, the main universities of the Milan region (Università degli Studi di Milano, Università di Milano Bicocca, Università Luigi Bocconi) collaborated with the local development agency, Province of Milan and the Chamber of Commerce in the creation, in 1996, of Milano Metropoli. This was formed to promote the sustainable re-development and socio-economic conversion of North Milan. It has supported the introduction of new technologies, the creation of small and medium enterprises and the reclamation and re-use of brownfield land, and led to the business reinvigoration of the area.

Box 5 – Example of enhancement of existing industries – Old Tech to High Tech

- This involves the introduction of new technologies that lead to enhancement of products, processes or services.
- **From eyeglasses to intensive care technology in Helsinki** Over a century ago, a company called Instrumentarium was founded to import eyeglasses and medical instruments. A major departure occurred in the 1970s through collaboration with medical researchers at Helsinki University to exploit a University invention to measure of carbon dioxide in expired air for monitoring patients under anaesthesia and intensive care. During the 1990s the company became a global player in this field and also developed software for handling clinical data and patient documentation. By 2001, Instrumentarium employed 5,400 people worldwide and had annual sales over \$1 billion (US). It was acquired in 2003 by General Electric, which led to the merger of Instrumentarium and GE Healthcare. The company maintains a major research facility in Helsinki, with important collaboration with the Helsinki University of Technology and the University of Helsinki.

Building university partnerships with the business community the Rolls-Royce plc experience

- Rolls-Royce policy is to direct the majority of its academic research into **University Technology Centres (UTCs)**
- selected long-term strategic partnerships with high calibre university departments with leading expertise in particular fields. - currently 25 universities worldwide
- adequate funding, staffing and infrastructure so that they can operate as an effective and integrated part of Rolls-Royce science acquisition programme.
- These partnerships create a cross-cultural working environment for Rolls-Royce and University staff in areas of basic science, applied research, staff training, and technology transfer
- Improving the motion response of ships through a better understanding of their operating environment one of the challenges of the UTC at the Norwegian University of Science and Technology and Marintek - first in Norway and the second in Scandinavia

Building university partnerships with the business community - the Cambridge-MIT experience

- One of the contributions CMI is the concept of Knowledge Integration Communities (KICs)
- KICs bring together academic researchers with industry participants, government policy makers and educators. Aim is to identify and pursue an integrated solution with consideration of use, for example, marrying stem cell and tissue engineering research with computational biology tools to develop new ways of tackling drug discovery bottlenecks or a potential application to a common problem (e.g. developing the technologies and the design for a 'silent' aircraft, to tackle the growing problem of aircraft noise).
- The KIC is a forum in which disparate stakeholders can interact to develop a multifaceted solution addressing technological, economic and social issues. The wider dissemination of the KIC model into the community includes their contribution to the debate about the EIT.

Universities and Innovation: diversity of transformations requires a diversity of university types

“Europe needs universities able to build on their own strengths and **differentiate** their activities on the basis of these strengths. Not all institutions need the same balance between education and research, the same approach to research and research training, or the same mix of services and academic disciplines. Research, although remaining a key task of the systems as a whole, is not necessarily a task for all.” EU Commission Communication 'Delivering on the modernisation agenda for universities: education, research and innovation' COM (2006).

“the spectrum of productions, across which higher education ranges, is and should be as diverse as that from opera and ballet ... to comic and tragic dramas. We do ... great damage if we allow all our productions to be judged as if they were tragic dramas.” *The Reform of Universities in Europe: Autonomy, Diversity & Excellence* The Euroscientist June 2008

“A comprehensive higher education reform with significantly increased funding and university autonomy as well as more specialisation, student selection and competition is needed to make the bloc's universities globally competitive, according to Brussels-based think tank Bruegel.” *Higher Aspirations: An agenda for reforming European universities* Bruegel Blueprint Series July 2008