Opinion of the League of European Research Universities

Competitiveness, research and the concept of a European Institute of Technology

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LEAGUE OF EUROPEAN RESEARCH UNIVERSITIES

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LERU was founded in 2002 as an association of twelve research-intensive universities sharing the values of high-quality teaching in an environment of internationally competitive research. The League is committed to: education through an awareness of the frontiers of human understanding; the creation of new knowledge through basic research, which is the ultimate source of innovation in society; the promotion of research across a broad front, which creates a unique capacity to reconfigure activities in response to new opportunities and problems. The purpose of the League is to advocate these values, to influence policy in Europe and to develop best practice through mutual exchange of experience.

Competitiveness, research and the concept of a European Institute of Technology

Summary

- The European Commission's proposal to create a European Institute of Technology (EIT) derives from the correct assertion that Europe's research performance must be improved and its impact on industry enhanced if Europe is to respond to changes in the global economy by becoming a focus for globally-competitive, high value research-intensive industry.

- The proposal sees that MIT has world leading research and strong industry impacts, and seeks to create a European equivalent.

- Before proposing solutions however, there must be a correct diagnosis. The challenge that Europe faces is threefold:
  - to strengthen its basic and fundamental research which is increasingly the key driver of innovation;
  - to strengthen existing and stimulate the emergence of world class universities, which are the most efficient locations for basic research and potentially powerful catalysts of innovation;
  - to increase research engagement and investment by European industry, to attract research-intensive industry to Europe and to enhance the birth and growth rate of research-intensive companies.

- An EIT is a diversion that fails to address any of these key priorities. A single EIT will not deliver significant benefit across Europe, whilst a networked EIT will lack the attribute that makes a university such as MIT so powerful, the capacity to reconfigure to respond to the changing research agenda. Both models militate against competition, will be unable to deliver the short and medium term benefits sought, are narrow and unimaginative in scope and are of doubtful sustainability.

- It is perverse to contemplate a new institution of doubtful utility when Europe already has a spectrum of powerful research-intensive institutions, from which, with appropriate competitive funding, there is the potential to create the cohort of internationally leading universities throughout its regions that Europe needs.

- Europe's responses to the above challenges should recognise that:
  - the mechanisms for strengthening basic research primarily rest with national governments, but European level intervention to stimulate competitiveness and excellence through the European Research Council is potentially of great importance. Developing capacity in new Member States so that they can rise to the competition should be assisted by regional and structural funds.
  - the research-intensive institutions that Europe needs are universities that co-locate a diverse range of powerful capabilities that permit them to reconfigure their research to pursue a fast changing research agenda, that are highly effective in winning research funds through competitive mechanisms, within a national funding system able to fund internationally competitive excellence.
  - industrial R&D will not increase as a consequence of exhortation. Other incentives are needed. Europe and its Member States should exploit their procurement budgets to stimulate innovative technology, and the creation and growth of research-intensive enterprises as successfully pioneered in the USA through Federal procurement rules.

Why might an EIT be needed?

1. The President of the European Commission, José Manuel Barroso has recently suggested the need for a European Institute of Technology, and the Commission has launched a consultation about the concept[1]. The implication is that there is a research deficit in Europe, and that the creation of a body similar to the Massachussetts Institute of Technology (MIT) would help to repair this deficit.

2. The primary motivation for the initiative is economic. The underlying propositions, with which we concur, being two-fold:
   - that the development of a globally competitive innovation-based economy is crucial to the future of Europe, to its cohesion and social and cultural dynamism;
   - and that world class higher education and research are key catalysts for this development[2].

3. The question is whether the proposed EIT is an appropriate response to these challenges. To answer this, we first explore the relationship between research and economic benefit and the nature of the institutions that Europe might need.

The underlying issue - how does research relate to economic competitiveness?

4. The global economy has changed dramatically in recent years. Mature, high-wage economies have moved away from traditional manufacturing towards high value, innovation-intensive products and high values services, taken to be characteristic of a "knowledge economy". They recognise the vital need to absorb innovations that permit them to address markets in novel ways, with new products and processes, and that radical new knowledge can be the most powerful way of doing this. Increasingly they look to basic or frontier research as the source of new knowledge that gives the greatest competitive advantage. These processes bypass the old paradigm of basic-strategic-applied research, in which basic research had a low priority because of the long lead times between new discoveries and their use in new products and processes. The most powerful competitive advantage is now realised by rapidly translating new basic discoveries into application.

5. Much global manufacturing is now being absorbed by rapidly developing, relatively low wage economies that have an educated workforce and a strong technical base, and which have become major foci of offshore investment. These governments recognise however, that, if their economic success continues and wage levels rise, they will need to compete as "knowledge economies", and many are making the infrastructural investments in research and higher education that are pre-requisites for doing so.

6. At the same time, the behaviour of major companies has changed. The increasing liberalisation of markets has forced many hitherto "national" companies to compete with international companies and, in order to survive, to become international or multinational themselves. Such companies need to be innovative and find ways of accessing appropriate research. Two important trends are apparent amongst research-intensive companies:
   - they are moving away from undertaking their own basic research, for no matter how large the company, their own research capacity is small compared with the global effort, and they are moving to a model in which they scan the much larger global research effort to gain access to the best basic research relevant to them through new forms of "open innovation";
   - they are locating their activities in their most important markets in association with centres of outstanding research.

7. It is increasingly recognised that research-intensive universities are the most cost effective centres of innovation in basic research rather than the specialised non-university institutions that have been developed in several European countries. In addition, the co-location of leading edge research with higher education plays a crucial role, both in training the next generation of researchers and the transfer of new knowledge into society.

8. It is for these reasons that there has been so much stress on the need to create internationally competitive research-intensive universities, why international league tables of university excellence have become important, and why, we presume, President Barroso has drawn attention to the role that MIT plays in the USA and internationally, and has inquired whether this is a model that can be transplanted to Europe.

9. We therefore pose three questions:
   - What sort of environment is required to permit an MIT to flourish and have greatest impact?
   - What sorts of higher education institutions does

Europe need to fulfil an "MIT-like" role?
- What consequential initiatives should the European Commission and Member States take?

The environment - supply, demand and investment

10. The creation of powerful, research-intensive universities is not in itself enough to enable them to play the role described above. Their effectiveness requires an industry that has the capacity to absorb their output. A coupled duality is required, comprising:
- **Universities** that are internationally competitive in research, that are able both to scan the blue skies of research possibility, as a means of creating the fertile ground in which tomorrow's innovation will be rooted, but also aware of and responsive to industry's perceptions of its needs and market opportunities.
- **Industries** that are competitive in innovative global markets, that, through their employment of research-trained graduates, are able to absorb research-based innovation, are aware of the potential of developments in the research base and interact strongly with it.

11. This virtuous, catalytic relationship is driven by patterns of investment. It requires investment by the state in the University research base, which, whether the institution is nominally private or public, takes place through core funding of the institutional capability, and also through the provision of ample project funding for which institutions can bid in competition.

12. The vital investment in R&D is however by industry. It must invest to gain access to the very best research, must invest in its own research knowledge so that it can be an "intelligent consumer" of basic research, and it must have a major development capacity to bring products and processes derived from new knowledge to market. Without this market-driven interaction with the university research base from R&D intensive companies, the impact of the publicly funded research on the national economy will inevitably be limited.

13. The "Lisbon" aspirations of the year 2000 recognised the vital need for this pattern of investment in research by both government and industry, targeting a headline figure of 3% by 2010. There are few European countries in which this investment target has been reached or appears likely to be achieved (Figure 1). In some countries, such as Sweden and Finland, not only has state funding grown significantly, but so has private R&D investment. In many others however, whether state funding is growing or not, there is a major shortfall of private R&D investment.

14. We suggest therefore that even if a European Institute of Technology were a desirable contribution to the European research base, the impact of such an institution would be conditioned by the absorptive capacity of companies located in European states and the routes by which economic benefit is delivered in them. There are therefore two coupled problems: how to increase the absorptive capacity of European industry for research and research-trained people; and how to ensure a world class research-intensive university base in Europe.

15. There are two potentially complementary ways of increasing industrial R&D spend:
- encouraging R&D investment by indigenous companies, including small and medium scale enterprises (SMEs), through fiscal incentives and use of the procurement power of the state;
- through the attractive power of relevant world leading research for international R&D intensive companies willing to locate some of their operation near to such centres.

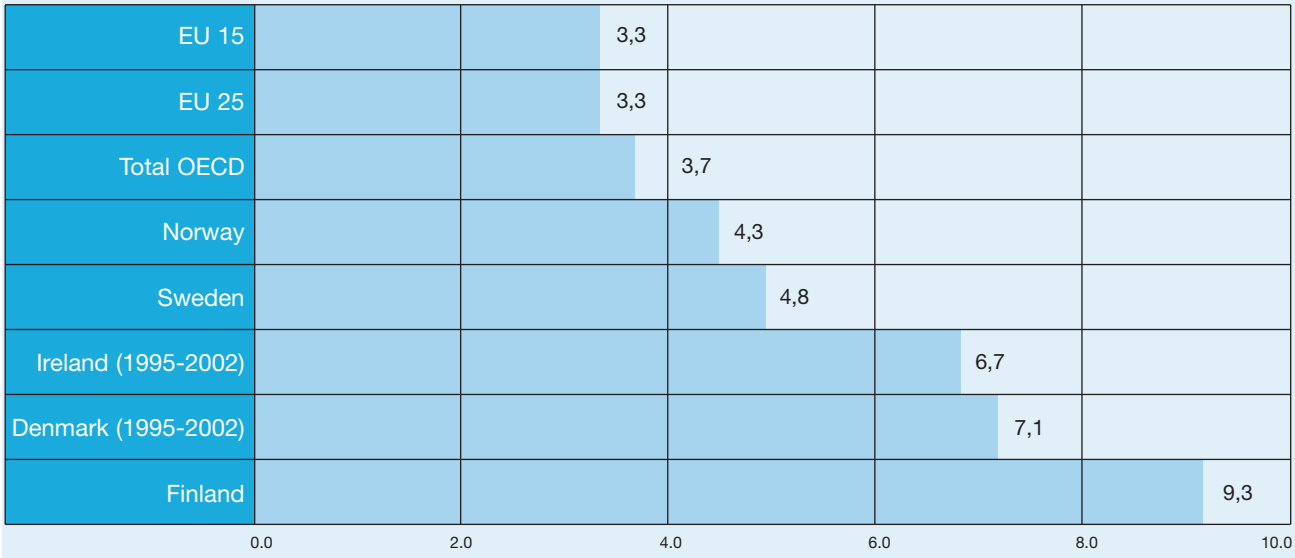
What research institutions does Europe need?

16. Whichever way industrial R&D is stimulated, the vital complement to it is a powerful and creative research base in which research-intensive universities play a key role. Institutions such as MIT have an economic impact in their regions partly because of attributes they share with many other universities across the world, partly because they have the potential to access a massive scale of funding and partly because of the absorptive capacity of regional industry for R&D and people trained in it.

Institutional breadth

17. The pace of scientific discovery and the demand for innovation have now become such that traditional disciplinary silos are no longer effective vehicles for the research effort, and trans-disciplinary configurations to address specific problems are likely to be ephemeral. Universities are unique in the disciplinary breadth of their research in such close proximity compared with either research institutes or industry, which gives them an extraordinary capacity to reconfigure

Figure 1. **Evolution of GERD – average annual growth rate of gross domestic expenditure on R&D 1995-2003 (or latest available year)**



Source: OECD

their research efforts to pursue new opportunities.[3] The co-location of this breadth of effort is crucial in underpinning dynamism.

Competitiveness

18. Whereas effective research-intensive universities must have core funding, universities that lie at the forefront of research have done so through their capacity to win national and international research funds in competition with others. It is crucial therefore that research allocations are not made by allocating funds to pre-determined institutions, but through competitive mechanisms. A rigid institutionalised system of selectivity runs a severe danger of fossilising the system at a particular point in time. It is essential for research-intensive universities to be dynamic and to enable new centres of expertise to develop, possibly at the expense of more established ones that have lost their edge.

The scale of funding

19. The various international rankings of universities and their research are dominated by US institutions. A large part of their research power is accounted for by the large federal research budgets that are available competitively (Table 1), in which 20 institutions receive 31% of all federal research funds for higher education. Although analogous data are not readily available for Europe, Cambridge University, for example, which normally ranks in the top 5-10 in international league tables for research, had an R&D income of $248M in FY 2002, approximately 1/2 to 1/4 of that of US top 20 institutions.

How well does the concept of an EIT match the need?

20. To what extent does the proposed EIT measure up to the challenge set out above? We suggest that although the motivation is laudable, the concept falls far short of what is required for a number of reasons:

Failure to create economic benefit

21. Although the existence of a common market is beneficial to the European economy, the capacity to benefit from it depends on national competitiveness. Benefit is delivered through national and not European processes. Would a single EIT located in a single Member State bring benefits to others? Universities create benefit nationally and internationally through those they educate and the research they

Table 1. **Separately budgeted R&D expenditures in the sciences and engineering by source of funds: top 20 research performers (FY2002, source NSF) (Dollars in thousands)**

		Federal government	State and local government	Industry	Institutional funds	All other sources	Total
1	Johns Hopkins U.	1,022,510	2,612	20,282	50,736	44,095	1,140,235
2	U. CA, Los Angeles	366,762	65,614	31,686	209,948	113,588	787,598
3	U. MI all campuses	444,255	5,298	33,252	135,634	55,285	673,724
4	U. WI Madison	345,003	41,795	16,746	197,769	60,788	662,101
5	U. WA	487,059	11,043	46,702	68,099	14,370	627,273
6	U. CA, San Francisco	327,393	24,316	33,577	117,848	93,831	596,965
7	U. CA, San Diego	359,383	21,931	32,299	106,112	65,283	585,008
8	Stanford U.	426,620	5,479	39,110	32,629	34,636	538,474
9	U. PA	397,587	2,155	26,994	44,542	50,991	522,269
10	Cornell U. all campuses	270,578	59,239	27,341	90,810	48,155	496,123
11	PA State U. all campuses	284,706	50,876	67,131	90,026	0	492,739
12	Duke U.	261,356	11,258	99,807	37,325	31,787	441,533
13	U. MN all campuses	295,301	60,705	26,572	74,211	37,476	494,265
14	U. CA, Berkeley	217,297	35,501	24,999	132,412	64,537	474,746
15	OH State U. all campuses	177,883	51,438	51,135	110,350	41,581	432,387
16	U. IL Urbana-Champaign	214,323	53,173	11,796	131,437	16,445	427,174
17	MA Institute of Tech.	330,409	150	88,626	7,301	29,005	455,491
18	U. CA, Davis	176,644	45,075	20,754	170,742	43,438	456,653
19	Washington U. St. Louis	303,441	7,537	16,100	59,522	30,360	416,960
20	Baylor C. of Medicine	259,475	3,047	18,729	59,501	71,172	411,924
	Total (Top 20)	**6,967,985**	**558,242**	**733,638**	**1,926,954**	**946,823**	**11,133,642**

Source: NSF Academic Institutional Profiles 2002

publish. The more direct benefits of specific institutions to industrial competitiveness are regional. Even in the case of an MIT or Cambridge, these benefits are to their regions and not to Idaho or to Slovenia. A single EIT would not bring a larger European benefit.

The unresponsiveness of a networked EIT

22. The Commission's consultation on the EIT has suggested that it might be a virtual institution, comprising a network of five areas of disciplinary activity, with a sixth as the principal node of the network, hosted by "six of the best universities in the EU".[4] This prescription would undermine one of the most important attributes of a research-intensive university, the capacity to reconfigure its structure to respond to new challenges by virtue of co-location of the parts. Of course, the dispersed nodes of the network could each re-configure with their host institution, with obvious complications for governance and network structure. At best the Commission would effectively be funding increased capacity in specific fields in six institutions. At worst it would be a recipe for confusion.

Absence of competitive stimulus

23. An essential characteristic of university research is its competitiveness in winning resources from national and international funding bodies, in contrast to the assured resources and lower cost effectiveness in basic research of many specialised government research institutes. The concept of the EIT involves providing ample up-front resources and therefore a less competitive funding environment. An easy ride is not the way to maximise creativity. The power of an MIT, Stanford, Berkeley, or Harvard derives from the competitive diversity of the US university system.

Unrealistic short and medium-term expectations

24. Universities in the international front rank have invariably taken decades if not centuries to develop. They are social organisations that have developed their own ethos and a working structure that is effective for their individual purposes. Their structure and function are not consequences of top-down fiat. The creation of a working structure, particularly one that of necessity involves long distance networking, is highly unlikely to begin to deliver the advantages of an MIT, or even an existing front-rank European research-intensive university, within less than two decades.

Narrow and unimaginative disciplinary scope

25. The discussion paper by Commissioner Figel'[4] identifies several areas of science and technology as the components of an EIT. Whilst the maximum technological benefits might well arise from these areas, a body such as MIT, though an "Institute of Technology", spans a broader scope, including the Humanities and Social Sciences, from which it benefits greatly, as do its commercial impacts. Equally, classical, broadly based universities in the US, such as Stanford, perform equally well as MIT in the commercial domain (Table 2). We are sceptical that the narrow model proposed by the Commission is the optimal approach to Europe's needs.

Doubtful sustainability

26. Even if the set up costs of an EIT were to be provided, its sustainability would depend upon being able to win very substantial recurrent funds for its research. These could not be provided adequately through the Framework Programmes because of their inadequate level of overheads. The component parts of the EIT would therefore depend upon national research councils agreeing to include them in their systems, creating problems of coherence both within and between national systems, and tensions with existing institutions.

How should Europe respond to the issues raised by the EIT debate?

27. We agree with the need to strengthen the European research base and to exploit it as a powerful catalyst for economic, social and cultural development, and we applaud these concerns of the Commission, which have led to the EIT proposal. Nevertheless we do not believe that the concept as expressed stands up to analysis - an analysis which is surprisingly absent from the available Commission papers.

28. We have argued above that there are three key issues for Europe:
- reinvigorating basic and fundamental research and ensuring its world-leading role;
- creating and strengthening the institutions that Europe needs: research-intensive universities to compete with the best in the world;
- stimulating interactions between the research base and industry through increased private sector engagement with R&D.

Reinvigorating basic and fundamental research[5]

29. Although much of the capacity to strengthen basic research lies in the hands of national governments, there is great potential to stimulate high levels of excellence through European level competition. The European Research Council is an attempt to realise this potential. Although the proposed levels of funding are small, we believe this to be a key development that could expand to become a major force for excellence in European research. We are concerned that a questionable enterprise such as the EIT might detract from the support for one of the most important recent initiatives in European research.

The institutions that Europe needs: world class research-intensive universities[6]

30. MIT has been taken as the model for an EIT. It is important to recognise that MIT is not a unique institution in the USA (Figure 1), and that its particular title, "….Institute of Technology" no longer reflects reality. MIT is now a much broader institution than at its foundation. It is now just a very, very good university. There is no magic in the "IT" suffix, and the Commission should not believe that an "EIT" would be different in kind from existing research-intensive universities in Europe. The challenge is not to use a relatively small sum from the Commission's budget to

Table 2. Comparative enterprise statistics three universities in UK/US

	Cambridge	Stanford	MIT
Inventions and patents			
Number of invention disclosures	141	350	512
Number of patent applications filed	61	404[a]	312
Agreements			
Licences granted	41	89	74
Materials transfer agreements	244	400[b]	
Companies			
Number of companies started		12[c]	20[d]
Spinouts	5[e]		
New start-ups assisted	28[f]		
Income/costs			
Licence income	$3.9m	$49.5m	$35.3m
Patent costs	$1.2m	$6m	$10.3m
Patent reimbursement	$0.7m	$1.5m	$6m
Period	Yr to 31/07/04	2003-2004	FY2005
Total R&D expenditures [g]	$248mh	$603mi	$486mi

Notes:
a. Includes provisional, continuation, continuation in part, divisional, original and utility.
b. Not tracked.
c. Number of companies which gave university equity as part of their upfront license fee; Office of Technology Licensing does not track which ones are start-ups, but estimates 5 of the 12 might be.
d. Venture capitalized and/or with minimum $500k of other funding; source of technology not defined.
e. Companies formed around university technology.
f. Companies formed by university staff and students using their own, rather than University technology.
g. Reporting period 2002-2003
h. All R&D
i. R&D in the sciences and engineering

Sources:
http://www.enterprise.cam.ac.uk/pdfs/CE002%20Statistics%20Factsheet%20PDF.pdf
http://otl.stanford.edu/about/resources.html
http://web.mit.edu/tlo/www/qfa.html
Cambridge University annual report 2003
http://www.admin.cam.ac.uk/univ/annualreport/2003/n.html
NSF http://www.nsf.gov/statistics/infbrief/nsf05315/

endow a single institution, whose impact would necessarily be small, but to work with Member States to develop mechanisms that will strengthen existing institutions to create a cohort of internationally competitive research-intensive universities throughout the regions of Europe.

31. Europe has a number of great universities that are still able to perform credibly in international rankings and in catalysing economic development in their regions. It is perverse to contemplate creating a new institution with all the uncertainties and difficulties listed above when it has institutions of great strength to build on. Table 2 compares enterprise statistics for three universities that lie in regions of dynamic, high technology growth, Cambridge University, MIT and Stanford University. The data are not strictly comparable, but they suggest that existing European research-intensive universities have the potential to act as major catalysts of growth provided that funding is competitive and there is an environment of research-absorptive industry. This will demand enhanced investment by Member States through competitive mechanisms, increased funding of basic research through the European Research Council and the stimulation of industrial R&D.

32. We recognise the importance of redeveloping research excellence and higher education capacity in new accession states. We believe that the way forward is not to forego the competitive mechanisms based on excellence that the European research base urgently needs, but to support capacity building in these states through regional and structural funds, so that they can exploit a more competitive European environment through their enhanced capacity, and so create international excellence.

Increased private sector engagement with R&D

33. Although in Europe there are areas of manufacturing industry (e.g. aerospace, pharmaceuticals, automotives) and some areas of service industries (e.g. telecoms services) that are research-intensive and able to interact strongly with the public research base, industrial engagement in R&D in some countries and in many sectors is weak.[7]

34. The birth-rate of small and medium enterprises (SMEs) and their rate of growth into major research-intensive companies has also, in general, been weak in comparison with the USA. The Lisbon declaration and exhortations by national governments have failed to stimulate increased private sector R&D investment.

35. We are sceptical that exhortation alone will lead to progress in this vital arena. Other incentives are needed. Moreover, although national headline figures of R&D expenditure are a useful index, it is more important to focus on underlying processes that create innovation[8]. In the USA, the power of public procurement has been a major stimulus to the development and growth of research-intensive sectors. This has been driven by investment by the US Department of Defence in new technologies, which has often been stimulated by the Defence Advanced Research Projects Agency (DARPA), and through the Small Business Innovation Development Act. The latter requires that 2.5% of the Federal budget for in-house R&D is expended on procurement from SMEs (the aspiration is to raise this figure to 25%). This and the power of the $200 billion Federal procurement budget resulted, last year, in the allocation of $6 billion for start-up companies. It is an incentive for SMEs to develop new technological solutions rather than offer last year's technologies. It has proved to be a great driver of innovation and the development of fast growing companies such as are rare in Europe.

36. We strongly advocate that the Commission should examine such incentives in collaboration with Member States. It would be a powerful means of exploiting the size of the European market in stimulating innovation and creating a strong interaction between the public research base and private industry. A small proportion of the procurement budget of the European health services, for example, could be a powerful incentive to innovation. Such a mechanism could stimulate interactions of the sort that the Framework Programmes, which have tended to focus on existing technologies, have so far failed to generate. The creation of a broad, enabling European framework could then permit Member States to move at their own pace in developing appropriate procurement mechanisms.

Notes

1 A European Institute of Technology? Public Consultation on the possible missions, objectives, added-value and structure of an EIT. European Commission, October 2005.

2 An agenda for a growing Europe: Making the EU economic system deliver. Report of an independent High Level Group chaired by André Sapir. European Commission, July 2003.

3 For example, Bio-X at Stanford University, a cross disciplinary grouping (biologists, chemists, engineers, mathematicians, medics etc) to explore the further implications of the Human Genome project; the Centre for the Study of Materials under extreme Conditions at Edinburgh University (physicists, engineers, chemists, earth scientists, computer scientists) to explore the potential for novel materials; the Advanced Studies Institute at Princeton University, which draws on the whole breath of the University to consider important issues for the future.

4 The European Institute for Technology. Information Note from Commissioner Figel'. European Commission, 2005.

5 Growth, Research-Intensive Universities and the European Research Council. League of European Research Universities, February, 2005.

6 Research-Intensive Universities as Engines for The "Europe of Knowledge". League of European Universities, 2003.

7 Although it is noticeable that Scandinavian countries, where public sector R&D is strong (Figure 1), and with a distinctive social model, lie near the top of the international league of GDP per capita.

8 For innovation success, do not follow where the money goes. Michael Schrage. Financial Times, 8.11.05.

LERU
Working Group on the EIT Concept

Members		
Geoffrey Boulton	(convenor and principal author), Vice-Principal	*University of Edinburgh*
Roger Bouillon	Professor of Medicine	*Katholieke Universiteit Leuven*
Douwe Breimer	Rector Magnificus	*Universiteit Leiden*
Jan Carlstedt-Duke	Dean of Research	*Karolinska Institutet*
Ian Leslie	Pro-Vice-Chancellor for Research	*University of Cambridge*
Marja Makarow	Vice-Rector for Research	*University of Helsinki*
Nigel Thrift	Pro-Vice-Chancellor for Research	*University of Oxford*

LERU Office		
Kari Raivio	President	*League of European Research Universities*
David Livesey	Secretary-General	*League of European Research Universities*
Katrien Maes	Executive Director	*League of European Research Universities*

LEAGUE OF EUROPEAN RESEARCH UNIVERSITIES

LERU Office
Huis Bethlehem
Schapenstraat 34
B-3000 Leuven
Belgium

tel +32 16 32 99 69
fax +32 16 32 99 68

www.leru.org
info@leru.org