

From tech transfer to knowledge exchange: European universities in the marketplace

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Introduction

At European policy level, universities are now seen as crucial economic drivers in developing and transferring knowledge to the commercial marketplace, as well as major agents in developing a more enterprising society by imbuing students with more entrepreneurial attitudes and skills. A number of European universities have pursued their own individual tech transfer, enterprise education and commercialization agendas in the past, often in response to national and local policy imperatives. Today the modernization agenda and the Bologna Process are catalysts of a genuine awareness of the need to change university–enterprise relations and make them a strategic component of the development of the university. In the Lisbon Agenda, universities are now seen as a crucial factor in the drive to improve competitiveness and innovation in the European economy.

Yet there is significant variation in the capacity and willingness of universities to undertake knowledge transfer activity in addition to the two traditional missions of research and teaching. Increasingly, interpretations vary regarding what is understood by the so-called ‘third mission’ (after teaching and research), and how it is meant to be implemented in higher education. The language is also changing: ‘tech transfer’ is being displaced by ‘knowledge transfer’ which, in turn, is being challenged by the concept of the more free-flowing multidimensional ‘knowledge exchange’ between the three sectors of the ‘triple helix’, comprising universities, business and government, to which some would also add the public. Measuring the impact of the knowledge transfer/knowledge exchange process in universities and ultimately on users, i.e. business and the economy, has now become a preoccupation of governing and funding bodies, as well as the Commission policy-makers. This means a demand for more analysis, which is now becoming available thanks to case studies from the Difuse (Driving innovation from universities into scientific enterprises, 2005–2008) project of the ECIU (European Consortium of Innovative Universities) and from the ‘responsible partnering’ and ‘doctoral careers’ projects of the EUA (European Universities Association).

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How the European policy agenda for universities is changing

At a meeting of the European Council in Lisbon in March 2000, the member states of the EU (European Union) set themselves the goal to make the EU by 2010 the “most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”. The European Council in Barcelona in 2002 set the objective to increase research investment levels to 3% of GDP (gross domestic product) by 2010, of which two-thirds should be funded by the private sector. The European Commission proposed the creation of a ERA (European Research Area) in January 2000 with the aim of contributing to better integration and organization of Europe’s scientific and technological area, and to the creation of better overall framework conditions for research in Europe. All the proposed outcomes are predicated on closer relations between universities and private industry.

The European Commission proposal establishing the EIT (European Institute for Technology) was published on 18 October 2006 with the objective of the EIT contributing towards the EU’s industrial competitiveness and reinforcing Member States’ innovation capacities (see http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0604en01.pdf). The EIT’s use of KICs (knowledge and innovation communities) is also intended to lead to the formation of either a partnership or a joint venture between the private sector, universities and research centres, a programme worth over €53 billion².

The need for changes in universities in line with the Lisbon Agenda was reaffirmed in 2006 when the European Commission issued a communication on “Delivering on the modernization agenda for universities: education, research and innovation”³. The communication identified nine areas where it was felt that changes should be made so that Europe’s universities could contribute to the implementation of the Lisbon strategy. Specifically, the relationship between HEIs (higher education institutions) and the business community was presented as a matter of strategic importance. Universities were called upon to make the “necessary organizational changes and build up entrepreneurial attitudes and management skills”, e.g. by creating local “clusters for knowledge creation and transfer”, and/or with business liaison, joint research or knowledge transfer offices. They were also encouraged to take greater responsibility for their own long-term financial sustainability by diversifying their research funding portfolios through collaboration with enterprises, foundations and other private sources.

²Council of the European Union, 11058/07, Brussels 27 June 2007.

³COM (2006) 208 final: ‘Delivering on the modernization agenda for universities: education, research and innovation’ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52006DC0208:EN:HTML>

Prerequisites to change in European universities

Change of the intended magnitude is, however, predicated on several conditions. First, that universities have the spare capacity to undertake significant business liaison and collaborative partnerships, Secondly, that they have the willingness. Thirdly, that they have the infrastructure, such as a tech transfer office with a business interface team or suitably qualified and experienced staff, as well as supporting policies on licensing strategies, IPR (Intellectual Property Rights) ownership and incentives to encourage academics to file patents. Fourthly, at a strategic level with buy-in from the Rector or Head, there needs to be an overarching institutional culture that recognizes the value of staff undertaking commercial, or knowledge exchange, activity as a contribution to society.

The move of state-run universities away from public funding towards developing a more diverse portfolio of income streams, including commercial income from business, has a number of other implications. There is a multiplication of financial risk and the need for robust long-term planning which accompany the potential for the university's greater sustainability. To introduce commercial operations, they will need systems which can deliver market research, costing and pricing models. This will lead many into the unknown territory of developing cost-control processes such as procurement, energy management, space management and the utilization of facilities and services shared with external partners.

There is also an increase in the regulatory side of university management. Institutions also need to respond more quickly to a wide range of market forces. One key prerequisite of moving to a more entrepreneurial model with greater autonomy is also the need, on the one hand, for more effective governance and, on the other, entrepreneurial managerialism; a concentration of power and authority in the hands of experts able to manage the university more like a large corporation, underpinned by an all-pervasive culture of acceptance of enterprise.

Indeed, the four classic characteristics of the entrepreneurial university model incorporate more than just control over resources and a diversified funding base, they require a strengthened steering core, an expanded developmental periphery, a stimulated academic heartland and an integrated entrepreneurial culture [1]. One may also add to that organizational capacity and infrastructure, as mentioned above. Universities daring to follow Burton Clark's paradigm face several barriers, broadly institutional and people-related. Since their foundation, most state universities have not been expected to be entrepreneurial and therefore have not been set up on this basis. In particular, there is a clash with the drive to increase the quality of the two mainstream missions: teaching and research. Most academics see their role as researchers and, to a lesser extent, teachers, but rarely as entrepreneurs. They suffer the same characteristics as any large organization, where entrepreneurship can easily be suffocated by five factors: the impersonal nature of large organizations; too many layers of approval; over-respect for rules and standards; over-measurement and planning cycles (by student evaluations, staff appraisals etc.); finally, the university is an environment which does not attract entrepreneurs.

Furthermore, in most European universities there is no system for rewarding enterprising activity at an institutional level and many university managers will turn a blind eye to private consultancy, which is endemic in many universities. Private consultancy acts as a disincentive to formalizing knowledge transfer as an institutional strategy because of fears of the potential loss to an academic's personal income. The reduction in public funding for some European universities is leading to a rethink on how to develop a more diverse portfolio of income streams, including deriving commercial income from business. This will lead many into the unknown territory of developing cost-control processes such as procurement, energy management, space management and the utilization of facilities and services shared with external partners. It also requires new kinds of employees to become university enterprise managers, with a commercial mindset but also a profound understanding of, and respect for, the academic world and the pursuit of knowledge for its own sake. This has proven to be a rare combination to find.

Models that seek to systematize universities into strict entrepreneurial categories often do not take into account the variety of constitutional and legal forms of HEI that exist in Europe that are not in a position to respond to the Lisbon Agenda, even though they may have the desire. There is still little understanding of the governance, commercial infrastructures and financial regulations that universities require in order to start out along the purist entrepreneurial path. However, the number of European universities openly seeking to replicate Burton Clark's paradigm [1] remains small.

Nonetheless, there has been a growing upsurge in the numbers of European universities adopting elements of the third mission, primarily through its association with the prospect of greater prosperity and/or in support of its business community and the employability of its graduates. Improving industrial and economic competitiveness has led some European governments, notably in the Netherlands and the U.K., to adopt policies to accelerate the transfer of new technologies from the science base in universities to the marketplace in what are by now familiar ways: encouraging start-up companies, liberalizing IPR, encouraging science parks, incubator units and, most recently, high-technology 'clusters' of companies near university campuses such as Twente or Maastricht and, finally, encouraging universities to work closely with the venture capital community.

However difficult this may be to achieve, and it may take a considerable time, there is evidence of more effective service delivery and greater financial sustainability across institutions. One well-established case of a relatively happy marriage of the three missions is Warwick University, where the outcomes of commercial activity were used to enhance the research budget, leading to greater esteem and buy-in from the academic heartland. Warwick has joined others with similar interests and profile to form the ECIU, where the focus has shifted from entrepreneurialism to exploring models of innovation, a process that has found resonance with a far larger community of European university managers and academics.

The EIUs (European Innovative Universities)

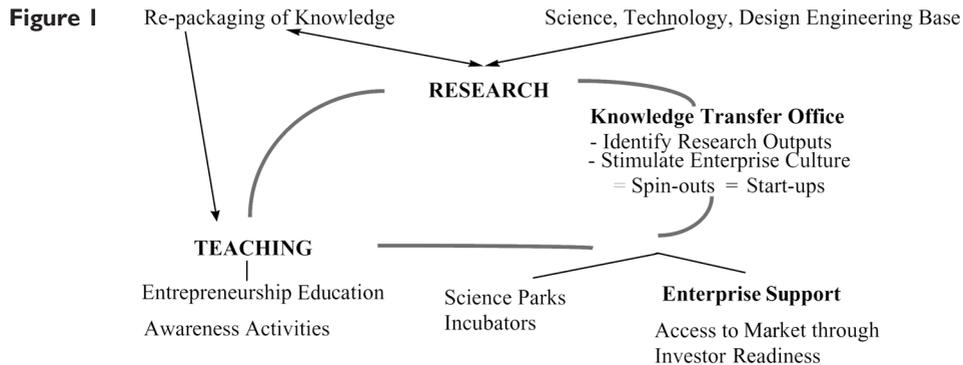
'Innovative universities' are vortexes which seek to combine use of knowledge with industrial, business and regional growth and provide a frame for a dynamic interaction between educational, R&D (research and development), business and government sectors. Many universities are increasingly starting to play the role of innovation co-ordinators, and they often become responsible for the co-ordination and management of the various phases of innovation, including regeneration, in their regions.

The role of the university in forming the knowledge or 'learning' region lies at the heart of this thinking. At a theoretical level, the connectivity between the knowledge economy, regions, clusters and the multi-actor triple (and quadruple) helix interaction were initially identified and studied by university researchers in the 1980s and the OECD (Organisation for Economic Co-operation and Development) in 2005 [2], but this has been most recently exemplified in recognition of the development of Oresund as a 'learning region' (as well as in other cities/regions such as Manchester/North-West England or Barcelona/Catalonia) where the economic, social and cultural aspects of life are embraced with the significant involvement of regional universities such as the Oresund University regional consortium (<http://www.uni.oresund.org/sw2006.asp>). The major role of universities in providing the research base for the knowledge economy may not be enough, however. Of the five essential ingredients, some may be able to provide four of the five, namely, research capacity, research quality, research applicability and a knowledge transfer infrastructure, but the fifth, a knowledge absorption capacity in the local economy, may be the one critical limiting factor ([3] p 34, [4] pp. 41–42).

National governments are increasingly aware of the potential value of universities to their local economies and through their ideas and presence could have a far greater regenerative effect if knowledge transfer processes can be efficiently operationalized. Many are not only significant local employers, but they have become joint venture partners in the development of high-tech science and business parks.

In earlier years, the science park had often been created at the university periphery as an add-on facility for the local business community with very little recognition of its role as a key component in the university–business knowledge transfer and innovation process. The distinctive change came for many innovative universities with the interconnectivity of their support for business (or business services, including science parks) with the development of their own commercialized products, which were usually research and technology-led outputs from Science, Engineering and Technology Faculties. Until the development of a dedicated infrastructure (e.g. the technology or knowledge transfer office, responsible for patenting and licensing IPR; and the research support office, responsible for procuring and/or managing research funding) many universities operated in ignorance of the opportunities they were missing for transferring their inventions and, in some cases simply their ideas, to society and to their region.

What distinguishes innovative universities from the mainstream is a holistic approach to knowledge transfer with the recognition that there is a



The virtuous innovation cycle

Source [6].

virtuous knowledge transfer and exchange cycle: namely, that spin-out and start-up activity, training programmes for business and the community [CPD (continuing professional development)], the science park strategy and the curriculum (with a bias towards professionally oriented programmes to enhance graduate employability) can be interlinked by a third mission strategy whose hallmarks are usually a pervasive enterprise culture, a strong underpinning by research outcomes and the formal recognition of this role or mission through a governance and management framework that joins up the innovation processes. For example, in numerical terms they fall within the 20% of European universities who engage with employers on curriculum design [5].

Research, as shown in Figure 1, has tended to provide the essential generator to enable a free flow of knowledge from the laboratories to the curriculum, leading to CPD and sparking the innovation infrastructure (comprising applications such as business start-up schemes, or incubators, with access to science parks for suitable companies).

The ECIU

The best embodiment of the EIU vision is exemplified in the charter of the ECIU, where “innovation is central to the shared ethos of the member institutions, whether in pedagogic and curriculum development; knowledge and technology exchange; and economic regeneration and links with industry, business and the public sector in their respective regions” (see <http://eciu.web.ua.pt/> and http://eciu.web.ua.pt/upload/fl_c3_22.pdf). The ECIU’s group of research universities is focused on a broader brief than knowledge transfer alone. It incorporates collaboration in innovative teaching and learning practice, enhancement of university–society interactions, internationalization of the student and staff experience, and active engagement in policy development and practice. Innovation is recognized as being central to a shared ethos of the members in pedagogic and curriculum development; knowledge and technology exchange; and economic regeneration

and links with industry, business and the public sector in the regions. The vision incorporates a commitment to achieving innovation by exchange of knowledge and best practice between members, notably including technology transfer and regional development. However, the University of Aalborg's mission statement captures the main aspiration of the EIUs by focusing on its twin linked aims of knowledge development, transfer and innovation: "the University will function as a knowledge-producing institution of cultural significance by contributing to technological, economic, social, and cultural innovation in society through entrepreneurship, as well as transfer, communication, and exchange of knowledge." (extract from the University of Aalborg's mission statement). The innovation badge in this case is more a commitment to a dynamic process of cross-institutional learning and exchange of best practice, rather than ownership of preconceived characteristics or meeting the requirements of a paradigm. Each has joined the consortium (by invitation only) by holding a number of common commitments.

The ECIU's 6th Framework project, Difuse, has profiled innovation pathways in the universities of Aalborg, Dortmund, Strathclyde, Twente, Warwick, the Politecnico di Torino and two Universities of Technology in Compiegne and Hamburg. It has also mapped common knowledge transfer policies and practice with reference to six development lines (for details see Table 1 and <http://eciu.web.ua.pt/page.asp?lg=en&pg=prjct>):

- Implementation of knowledge exploitation, e.g. patenting, licensing and IP (Intellectual Property) commercialization.
- Commitment to applied research, e.g. contract and collaborative research and income and outputs.
- Interface to the business community, e.g. science parks; best practice in transferring knowledge through university faculty and students e.g. knowledge transfer partnerships, student placements and graduate consultancy schemes.
- Business creation, e.g. creation of spin-outs and start-ups, incubators and science parks.
- Regional policy context, e.g. their regional strategy, working in close collaboration with their regions to make a strategic partnership between local business, the local community and governmental agencies and their role in regeneration and support for the local economy.
- Building entrepreneurial culture; teaching methods such as enterprise education; incentive schemes for staff, opportunities for start-ups.

The project has revealed reveals five features of common practice:

- Innovation cannot be limited to knowledge transfer, it is far more wide-ranging and all-pervasive. It affects governance, the curriculum, teaching and learning methods, as well as facilities such as provision of student start-up support and creativity labs.
- Knowledge transfer does not lead to significant income generation, but it is seen as part of their civic responsibility, which is a key aspect of regional regeneration; it also offers an alternative career or self-development path for students, which can be supported (e.g. Warwick University).

Table 1 University knowledge-transfer activities: a sample of six universities from the Difuse project (2005).

University knowledge transfer statistics (2005)	Aalborg 2005	Dortmund 2005	Hamburg University of Technology 2005	Torino 2005	Twente 2004/2005	Warwick 2004/2005
University budget (€ million)	n/k	201	73	209	261	330
R&D budget (€ million) (public and private sources)	30	38	13.5	33	*63.8	70
Patents filed	32	6	43	34	n/k	13
Patents granted	1	1	2	1	29	10
Licensing income (€000)	35	1.5	70	7	n/k	248
Spin-outs from university research	3	0	0	7	28	0
Staff and student start-ups	-	15	13	-	13	2
Number of science parks (with significant university share)	2	2	1	5	1	4
Number of incubators	1	1	1	3	4	0
Number of full-time equivalent knowledge transfer staff	19	5	40	10	11	12

*, all external sources.

Source [6]. n/k, not known.

- The greater the number of dedicated knowledge transfer staff (the optimal number is ten) and quality of the knowledge transfer infrastructure, the greater the chance of a high return in licensing income, start-ups or patents filed (e.g. Hamburg University).
- Enterprise education offers an alternative path to a career for students. The dedicated staff-student start-up programme at Twente University, for example, the Temporary Entrepreneurial Positions (“TOP”) programme has led to significant start-up and spin-out activity which benefits the region and the individual more than the university.
- All of the eight universities acknowledge the importance of embedding a pervasive entrepreneurial culture: notably with programmes to encourage entrepreneurship amongst students and faculty.

The development of entrepreneurial students

Opinions divide over the value of enterprise education and entrepreneurship training as part of an IWIS (institution-wide innovation strategy), though ECIU members tend to agree that it is an essential step towards building an entrepreneurial culture. Some universities make an unnecessary distinction between delivering innovation to the economy in the form of inventions and scientific knowledge (classical knowledge transfer) and the university as an agent for the development of entrepreneurial attitudes and skills. In the longer term, it is the latter that will significantly change the local economy. If entrepreneurs can genuinely be trained, or at least developed, at university, they will ultimately become engines of a market economy, including social enterprise, and it will be the ventures they create that will serve as catalysts for technological progress [7].

The Difuse case studies demonstrate a greater focus and emphasis on enterprise education than most universities. For example, Twente University actively supports the entrepreneurial activities of students and facilitates via the Student Union and its taskforce USE (University Student Entrepreneurs). Students can rent office space at below market rates, USE organizes network activities and the Dutch Institute for Knowledge Intensive Entrepreneurship, Twente University (NIKOS), the enterprise centre, offers students various curricular and elective courses and workshops on entrepreneurship and entrepreneurial skills. Aalborg University offers various courses on entrepreneurship to students, staff and members of the public. Developing the focus on creativity as a broader dimension of enterprise within the student body has expanded steadily: a creativity laboratory has been set up and is accessed by business and industry, by researchers and students and often in a broad co-operation where the business associate provides an assignment which the students have to solve in a creative and innovative manner.

Warwick University’s Senate set the medium-term target in 2001 that the university should provide enterprise teaching to 20% of undergraduates, with an initial emphasis on Science and Engineering, By 2004/5 the numbers taught by the enterprise group at Warwick Business School had risen to 776 students.

This reflected increased numbers on existing courses and modules, plus three new modules. In 2005/6 the new course 'Starting and Running a Business' was compulsory for all second year Engineering students, and in 2007 all Warwick Business School undergraduates had a mandatory module in Enterprise.

Dortmund University established a new Chair for Management of Innovation and Business Formation in the Faculty of Economic and Social Sciences in October 2006. Entrepreneurship teaching provided by the Faculty of Economic and Social Sciences includes: start-up management, marketing and financing; technology and innovation management; business plan development and project management and planning. For some departments the course is mandatory, for others it is a minor; in the other cases, participating students receive a certificate.

Many other European universities are already considering the extent to which their researchers and Ph.D. holders are adequately prepared for entering commerce and industry and require enterprise training. A further debate is taking place, currently addressed by the EUA's Doc-Careers project, about the extent to which enterprise and innovation skills should be targeted specifically at the doctoral and researcher level in higher education in order not only to prepare candidates for the wider employment market, but also to alert them to technology transfer opportunities in their own universities (see http://www.eua.be/index.php?id=48&no_cache=1&tx_ttnews%5Btt_news%5D=431). A common approach to enterprise education across the Difuse partners is seen as an essential part of embedding the pervasive entrepreneurial culture.

From knowledge transfer to knowledge exchange and open innovation

Evidence is accumulating that technology transfer does not deliver the bonanza of new resources to a university except in a few well-known cases (e.g. Oxford, Leuven, Lund and Cambridge Universities, and Imperial College). For the majority of European universities, the "home runs in technology transfer are few and far between" [8] and few but the most exceptional European universities are capable of producing a significant flow of commercializable inventions with a deal flow. The U.S. benchmark is only 1 research spin-off per €70 million of external research income; U.K. best practice is 1 per €7 million of research income (e.g. Imperial College), but the average U.K. university spin-out occurs from €14 million gross research income. Other knowledge exchange channels are 2–3 times as important in terms of impact: principally in consulting, publications, 'entrepreneurial' graduate recruitment, CPD and research collaboration.

Furthermore, Warwick University's income generation patterns indicate that the main external income sources available to many HEIs are not generally from traditional knowledge transfer: they are, notably, catering and hospitality (income from campus conferences); overseas student fees; contract research projects and consultancy; management training and short courses (CPD); fundraising, alumni donations and subscriptions and campus retail. Other minor income streams include science park rental income, licensing of assets (inventions) and the sales of software/e-materials and property development.

There is quite a different way of seeing university–business relations. If one views university–business relations in the far wider, more mutually beneficial context of knowledge exchange, then the relationship is not simply one of the supply-side issue of commercialising research, IPR management and the other concerns (all legitimate) of the last two decades. It is also about demand-side issues of human resource capacity, partnering, trust and collaborative culture. This is less tainted with an entirely research-driven agenda and it better expresses the ‘collaborative’ model of knowledge transfer which is all-encompassing. Viewed as knowledge exchange, a university can focus on a spectrum of activity which includes research, but which stretches beyond to encompass consultancy, CPD and learning and teaching at all levels.

Other knowledge exchange channels can be 2–3 times as important in terms of their impact: e.g. consulting, publications, ‘entrepreneurial’ graduate recruitment, CPD and research collaboration. At MIT (Massachusetts Institute of Technology), a model for international knowledge transfer in higher education, an analysis of commitment to knowledge transfer at the business and community interface indicates: consultancy (26%); collaborative research (12%); publications (18%); employment of graduates (17%); co-supervising (9%) and patents and licenses (7%) [9].

The term knowledge transfer is too restrictive in terms of the innovative practice of knowledge exchange, which is defined as a set of policies and practices which enable the efficient and effective exchange and co-creation of knowledge between producers and users: a virtuous circle of multiple-track engagement between knowledge producers (typically scientists, but potentially all academics) and knowledge users (typically policy makers, practitioners, stakeholders, businesses, social enterprises and other publics) so that the boundaries between the producers and users ultimately become merged.

The knowledge exchange model ensures a synergy and inter-connectiveness between these two dynamics, a virtuous circle that provides business with the knowledge, skills and competence they need while business and the community can, in turn, influence the development of the curriculum, learning methods (e.g. tutoring on student placements), research, governance and public engagement. When graduates move into the world of work they take with them the body of knowledge, skills and aptitudes acquired at university. While in the world of work they acquire additional knowledge, additional skills and additional aptitude. This is where knowledge transfer begins to depart from the feedback model on which current policy is largely based. For when the graduates seek to return to higher education for CPD and other training, as many more of them do several times across their lifetime, they bring this additional knowledge to bear on the university. An attentive university will use this to refresh its curriculum, update its professional knowledge, feed into its research agenda, create collaborative research opportunity and develop its learning and teaching markets. Moreover, these students then return to the world of work, where the cycle is repeated.

There has been recognition in recent years of the need for open innovation partnerships between academia and business which recognize the importance of a dynamic interplay between creativity and technology to produce commercializable inventions. It is, however, a process that requires different knowledge

transfer models than those of traditional manufacturing industries. Philips' open innovation model for university–business relations, promoted in the EUA's responsible partnership project, recognizes that business and universities need new ways of working together, involving multiple interfaces of knowledge exchange ranging from student placement to collaborative research. The paradigm of open innovation recognizes the importance of the multiple pathways of knowledge flow and moves from closed innovation, where the innovation is carried out inside an organization, to open innovation, where it is conducted in an open collaborative manner between partners, and recognizes the multi-layered nature and long-term value of a strategic relationship.

Responsible partnering is a voluntary code of conduct for innovative companies and PROs (public research organizations), notably universities, to enable them to collaborate more effectively and at the same time contribute to the achievement of their respective missions in a more sustainable way [10]. The responsible partnering guidelines have been developed by four European associations: EIRMA (European Industrial Research Management Association), representing industry; EARTO (European Association of Research and Technology Organisations), representing research organization; ProTon (Pan-European network of knowledge transfer offices); and EUA, representing 800 European Universities. They are based on the analysis of the main problems preventing effective collaboration and also on the success stories where such collaboration has been achieved, such as in the Philips model of Open Innovation (see <http://www.eirma.org/members/conferences/sc2007/02-vandenbiesen.pdf>).

For optimal effect, a university needs a knowledge management strategy to underpin its responsible partnering processes within a knowledge exchange model. This approach allows business and the community to participate and influence the direction of the university at a wide number of interfaces:

- Strategic business alliances and collaborations;
- Consultancy, business support and expert advice (each way);
- Joint R&D ventures with business;
- Joint research projects (notably contract research);
- Designing CPD/professional training (short courses for business and professional communities);
- Contracting with each other for the commercialization of IP, by licensing or spin-out formation;
- Student placements (graduate and undergraduate) in business and the community;
- Student incubators (enterprise/start-up support) jointly supervised;
- Graduate/post-graduate employment panels;
- Dissemination of ideas via publications with joint articles;
- Co-publication and sales of software/materials.

This model is claimed by Philips to work particularly well where R&D is relatively close to the market (e.g. electronics and aerospace). The interesting concept is the openness of the relationship between the partners, the recognition of how relationships exist at various levels, and how the model draws on the mutual benefits of association between the partners and remains dynamic over time. These

partnerships are characterized by common self-interest, complementarity of effort and offer a potential full range of activities within a cycle of knowledge exchange. There could be major projects at any one time as well as student placements and collaborative research, involving a fluidity of personnel (as suggested in the Philips and the Finnish Centrum models) across sectoral boundaries. Knowledge exchange is multi-dimensional: it recognizes there is linkage between pure research and the opportunity for applying the outcomes to a commercial or community/social environment. There is no lesser value placed on research activity, simply the recognition that research activity should be harnessed, wherever possible, as a key part of the value chain leading to a more fruitful engagement with the community and with industry.

Knowledge exchange is now a key component of the stated mission of a number of European universities, notably the University of the West of England, Aalborg University and Strathclyde University. However, knowledge exchange has one important weakness: the lack of metrics with which to compare and measure the success of its impact. In its strong formula, the classic components of tech transfer, as defined by the number and value (estimated) of spin-outs, number of invention disclosures, growth rates, external investment level, share value at the IPO (initial public offering) stage, licensing income or royalties and longevity of start-ups, is easier to evaluate than knowledge exchange, whose all-encompassing nature is both a strength and a weakness. That is not to say that there is no measurable impact, but there has been to date a lack of scientific rigour in this whole area of researching knowledge transfer at the European level which makes it difficult for policy formulation [11]. Nonetheless, there is recognition that while the current evidence base for measuring the economic impact of knowledge exchange on a cost-benefit basis is very thin, knowledge exchange is more a way of working where the value of cultural change within the university has to be seen as a key part of its impact.

At its heart, innovation is a people problem, not a technological problem, and knowledge exchange offers universities a new vision for business–university and community–university relations, leading to cultural changes to the university’s internal processes and practice.

Conclusions

The last two decades have seen considerable progress towards the present wide acceptance of the crucial role of universities in promoting economic competitiveness, regional regeneration and creating innovation hubs for business and the community; a process which the European Commission recognizes and wishes to see extended under the Lisbon Agenda. For some European universities, notably the innovative group, which includes many beyond the members of ECIU, this is now accepted as a core, and not just a marginal, activity. This has not been reflected, however, in the core funding made available to universities in comparison with teaching and research.

Problems remain, however, in accelerating the knowledge transfer and exchange processes. It is apparent that demand from industry for university

knowledge, as well as the absorptive capacity of local industry, may be lacking [12,13]. Furthermore, large parts of industry, notably the SME (small- and medium-sized enterprise) sector, often appear not to be aware of the value that a close university–business relationship can bring them. If these policies are really to succeed, it will require thousands of individual relationships between industry and the academic community to be developed, probably with European and national intervention. For this to happen, much stronger systematic mechanisms will be required to motivate the two communities to become better acquainted. Significant numbers of academics do not yet see a role for themselves in knowledge transfer activity, lack the incentives to become more involved and need further guidance on developing best practice in partnering and enterprise training, such as those published by the EUA.

However, if knowledge transfer schemes are to work more effectively, knowledge exchange, as defined, embraces learning as well as research. It becomes not just one among many internal service functions such as industrial liaison or licensing, but more a question of mission; not so much what is done, but how it is done. For this reason early reactions to knowledge exchange have been positive from both sectors, as the concept avoids the narrow research and technology push, focuses on market need and moves the debate on to a more strategic footing and away from income generation as the sole determinant of a university's external activity. There is still work to be done on measuring knowledge flows and evaluating knowledge exchange channels (e.g. isolating situational variables in different countries, such as absorptive capacity and connectedness [13,14]) before the concept takes root in more than just the innovative group of European universities. Knowledge exchange does nonetheless attempt to address the 'missing middle' as identified by Etzkowitz [15] between attempts to embed universities in their localities and the realities of implementation and offers a vision and a formula for university–business/community collaboration.

References

1. Clark, B.R. (1998) *Creating Entrepreneurial Universities: Organizational Pathways of Transformation*, Pergamon, Oxford
2. OECD (2005) *The Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data Supporting the Contribution of Higher Education Institutions to Regional Development*, OECD Programme Report, OECD, Paris
3. Garlick, S., Kresl, P. and Vaessen, P. (2006) *The Oresund Science Region: A Cross Border Partnership between Denmark and Sweden. Peer Review Report on the OECD/IMHE Project: Supporting the Contribution of Higher Education Institutions to Regional Development*, OECD/IMHE, Paris
4. Reichert, S. (2006) *The Rise of Knowledge Regions: Emerging Opportunities and Challenges for Universities*, EUA, Brussels
5. Crosier, D., Purser, L. and Smidt, H. (2007) *Trends V. Universities Shaping the European Higher Education Area*, EUA, Brussels
6. http://www.difuse-project.org/Content/download/DIFUSE_D4_TT_practices.pdf
7. Mueller S.L. and Goic, S. (2003) East-west differences in entrepreneurial self-efficacy: implications for entrepreneurship education in transition economies. *International Journal of Entrepreneurship Education* 1, 613–632
8. Hughes, A. (2003) Knowledge transfer, entrepreneurship and economic growth. Some reflections and policy implications. in *Entrepreneurship in the Netherlands: Knowledge Transfer Developing High Tech Ventures*, EIM Business Policy and Dutch Ministry of Economic Affairs, The Hague

9. Agrawal, A. and Henderson, R. (2002) Putting patents in context. *Management Science*, **48**, 44–60
10. *Responsible Partnering – A Guide to Better Practices for Collaborative Research and Knowledge Transfer between Science and Industry* (2005), EIRMA (in association with EUA, ProTon Europe and EARTO), Brussels
11. Arundel, A. and Bordoy, C. (2002) Developing internationally comparable indicators for the commercialization of publicly funded research, United Nations University, Maastricht
12. Lambert, R. (2003) *The Lambert Review of Business-University Collaboration*, Final Report. HMSO (Her Majesty's Stationery Office), London
13. Cohen, W. and Levinthal, D. (1990) Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**, 128–152
14. Agrawal, A. (2001) University to industry knowledge transfer: literature review and unanswered questions. *International Journal of Management Review* **3**, 285–302
15. Etzkowitz, H. (2006) Making science cities: The 'Triple Helix' of regional growth and renewal. in *The Embedded University in the Science Economy: Capabilities, Contexts and Expectations* (May, T. and Perry, B. eds), ESRC (Economic and Social Research Council) Network Report