Policy forum

A system approach to tertiary education institutions: towards knowledge networks and enhanced societal trust

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This paper argues that strengthening the knowledge dimension and external societal links (i.e. 'system linkages') are critical in making the institutional changes required for tertiary education institutions (TEIs) to meet the needs of global competition and the knowledge economy. In public policy terms, by focusing governmental and political actions on the growing appropriation of scientific and technological culture by society and on the external dimension of knowledge institutions, we require TEIs to strengthen their capacity to make the critical internal changes for modernizing their systems of teaching and research within a path of diversity and specialization, without compromising quality. Furthermore, by strengthening their institutional integrity together with enhancing their external links with society, TEIs are asked to carefully improve their relationships with economic, social and political actors, thereby creating 'new' reinforced institutions that have gained societal trust. And this must be achieved in a way that will promote new leaderships for our institutions.

Tertiary education systems are under pressure to meet demands imposed by a globalized knowledge-society without compromising quality deliverance. For example, in Europe, although most institutions and their staff have recognized the need for change for many years, the way institutions are organized, either internally, or through traditional links with society, as well as their structure of incentives, have continuously delayed reforms. Consequently, it is only in recent years that reforms, conducted directly by governments, have emerged in many different countries and political regimes. The Portuguese system is no exception to these mounting pressures and change has been recently introduced through governmental actions (Gago and Heitor, 2007).

As a starting point (e.g. Conceição and Heitor (1999)), we must recognize that scientific progress is a source of development and that TEIs play a critical role in this process. Public resources invested under rigorous international assessment policies lead to new knowledge, better advanced training of new human resources for the society, new ideas and processes, which increasingly result in innovation, modernization of institutions, improved quality of living, economic productivity and better employment. Some 40 years after Ziman (1968) launched the discussion on Public Knowledge and 30 years after his work on Reliable Knowledge (Ziman, 1978), to appreciate the significance of scientific knowledge one must understand the nature of science as a complex whole. In Real Science (Ziman, 2000), we are reminded that 'science is social', and refers to 'the whole network of social and epistemic practices where scientific beliefs actually emerge and are sustained'.

Our goals require the renovation and expansion of the social basis for scientific and technological development. This calls for strong conviction not only from the scientific and technical professions, and public and private research organizations, but also...
from students and from the general population. The growing appropriation of scientific and technological culture by society is thus one of the central aspects of the argument of this paper.

It is in this context that the US system is often taken as a world reference, although analysis has shown that it is of utmost importance to understand its policy diversity and mixture of public and private incentives (Conceição et al., 2004). Moreover, the long history of past investments and current division of labour or specialization cannot be replicated in systems with a lower scale and complexity. The key elements of the US history are those of diversity of policies and increasing ‘institutional specialization’ and of the clarification of the unique roles of the private and public incentives to support science and technology (S&T).

In the same way that the US S&T system as a whole is taken as a worldwide reference, so the US university system has also been used as a role model for its fast rate of response to the economic changes and contribution to the creation of wealth (National Academy of Engineering, 2003). The understanding, mainly by European counterparts (European Commission, 2003), that the universities are gradually being viewed as important engines of economic growth and development, instead of mere institutions of higher education learning, has been evident for many years (Saxenian, 1986), as there is increasing evidence of their importance as developers of regional industrial and technological development (Cooke and Huggins, 1996). This is a role that US universities, and especially research universities, have assumed throughout the second half of the 20th century (Rosenberg, 2002).

Here, too, as with the entire US system, there is the perception that private funding, associated with a high level of industry–science relationships, is very high and stimulates a very dynamic academia, which contributes much more directly and with greater impact to social and economic development at both regional and national level. The possibility of obtaining funding from private sources and private incentives (such as intellectual property rights) is also very appealing to the European universities that struggle to cope with increasing demands for change and with being more closely engaged with society.

At a time when they have increasing financial difficulties, derived from public budget constraints, there is the expectation that these closer links between research and application and usefulness in society will be translated in more direct and immediate financial flows (as suggested by Neave (1995)). However, this perception is leading to an institutional convergence between what universities do (and are supposed to do) and what firms and other agents do. In fact, more than a decade after Clark (1998) launched the idea of ‘entrepreneurial universities’, much remains to be learnt about their impact and analysis (Conceição and Heitor, 1999). Some have clearly considered this convergence a potential threat to the institutional integrity of the university and the future of scientific research due to the commoditization of knowledge (Nelson, 2004).

Above all, we follow Vest (2007), a former president of MIT, who stated in his most recent book that:

…what is best about American higher education – we create opportunity. That is our mission. That is our business. That is first and foremost what society expects of us.

The issue is not to ‘save the university’, but rather to understand who will play the fundamental and unique role that universities have played in the overall cumulative system of knowledge generation and diffusion. It appears that the US is not willing to allow this integrity to be jeopardized. By misunderstanding the US policies towards university-based research, there is a grave danger that European university policy will destroy these basic functions, which would not only be detrimental to the global production of knowledge, but would also harm the development prospects of Europe itself, in comparison with those of the US.

It is in this context that the paper addresses the challenges and opportunities for reform in OECD countries, in a way that aims to deepen the emerging discussion facing the reform of TEIs and tertiary education systems in the coming years. The key role for policy makers and governments worldwide is to select priorities and make the correct decisions about where and how to start the reform process.

For the purposes of this paper, we will use examples from the current Portuguese reform of tertiary education in order to illustrate our main arguments. This is because it is about two years since the OECD’s Education Policy Committee met in Lisbon to review Portugal’s higher education policy in December 2006. A number of steps have been taken to follow up on the committee’s recommendations and a thorough legal reform of the Portuguese tertiary education system has been completed (OECD, 2007). It considers significant changes in the internal system of governance of TEIs (including the management structure), as well as in their external societal relations (including internationalization, research...
partnerships and business links, as well as external evaluation and accountability), which have been implemented together with a unique increase in the public investment in S&T.

The rest of this paper focuses on four interrelated issues, which are considered to be central to understanding the knowledge dimension and external societal links of TEIs:

- improved funding and equity for increased participation rates;
- strengthening knowledge production and internalization for improved knowledge networks;
- fostering diversified systems for improved knowledge transmission and learning;
- strengthening institutional integrity together with systems linkages.

The paper then summarizes the overall need to strengthen societal trust in TEIs.

**Promoting greater participation rates: new funding schemes for improved equality of access**

We need to open up tertiary education worldwide by strengthening the ‘bottom of the pyramid’. In fact, our underlying assumption is that ‘students matter’ and that it should be clear that the main reason for governments to increase funding for tertiary education is to increase participation rates and extend the recruitment base and the number of students in tertiary education. At the same time, it is also clear that new opportunities are required to give students more flexible pathways across different types and levels of educational qualification, including through recognition of prior learning and credit transfer, in order to reduce repetition of learning. Thus, increasingly diversified systems are required, as will be discussed later in this paper.

It is also clear that the need to modernize funding mechanisms and ensure a better balance between institutional and competitive funding for tertiary education is leading the discussion in governments worldwide (Conceição et al. 2003). It appears that, rather than discussing the details of funding formulas for institutional funding mechanisms, it is more important to review the overall share of institutional and competitive funding sources, as well as to promote student support mechanisms. This certainly includes the need to preserve the institutional integrity of the institutions (as discussed below), as well as to create flexible financial mechanisms to attract and secure new talents in our institutions and to meet the global challenges of research and international competition. But it may also require, as argued by David and Metcalfe (2007), increased competition and collaborative patterns among funding agencies at an international level. In Europe, we certainly need to strengthen the role of the European Research Council and to foster additional competitive funding schemes with a transnational configuration by promoting collaborative arrangements between the national funding agencies in Europe.

In this regard, by and large, the financing of tertiary education (and of science and innovation) has occurred along rather traditional lines, at least in Europe. Governments directly undertake research and development (R&D) or subsidize (directly or indirectly, through tax measures) R&D performance and technological innovation. Governments raise, or forego, revenue to pay for this support. Yet, the history of science is rich with varied means of financing science and technological innovation. More importantly, developments in the size, integration, and technologies available in global capital markets present the opportunity to think about new financing possibilities. These involve both the channeling of resources from the global liquidity pools to S&T, as well as enhanced risk management tools that are as important for ‘financing’ as channeling money.

The question to be addressed is how far the different and innovative sets of incentives and funding mechanisms developed in modern financial markets during the last decade can be expanded and adapted to finance scientific progress and to attract more people to tertiary education? What have we learnt about experiences with loan systems, venture capital, risk capital and tax incentives?

Still, the key issue is how to increase and balance loans and grants for students, as well as to develop innovative loan systems and to combine them with flexible legislation to accommodate reasonable student incomes through part-time work, while they are at TEIs. Barr (2008a) keeps reminding us that the goal is to provide free education to all students, by guaranteeing a supply of graduates to share the costs. The correct amount to be shared among the tax payer and graduates, as well as other private sources, is still to be demonstrated (at least using scientific grounds…), currently it is relying very much on socio-political grounds!

Although income-contingent loan systems are becoming a typical reference worldwide, as has been clearly acknowledged by the OECD, it should be noted that their applicability is particularly dependent on the characteristics of the existing fiscal system. That is why an innovative system of student loans with mutual guarantee underwritten by the Portuguese state, was introduced in autumn 2007, which complements the system of public grants, thereby improving access to higher education for all students. About 3000 loans were contracted in the first six months through the banking system. This represents an important new achievement for Portuguese families, which follows current practice in modern societies at the OECD level.

Gallagher (2008) has commented that:

…the Portuguese initiative satisfies the key policy criteria: it is a horizontally equitable
scheme; it represents good value for students; it is financially sustainable at higher volumes of student take-up; it is low risk for government and financial institutions; it avoids the need for additional administrative infrastructure. The loan facility reduces disincentives to study by covering reasonable living costs while deferring repayment obligations till after graduation. The 10% guarantee offsets lack of collateral in financing human capital investments. The allowable repayment period (twice the period of study) is normally sufficient to permit students to make loan repayments without committing a disproportionate share of their income after graduation’.

With regard to the new Portuguese loan system, Barr (2008b) has commented that he would ‘applaud the facts that: 1) the scheme is universal; 2) supplements existing grants rather than replacing them, hence extends students’ options; 3) has no blanket interest subsidy; 4) has a very innovative mutuality element, which is the key that makes it possible for the scheme; 5) to make use of private finance’. The loans scheme also has incidental benefits, by virtue of the progression requirements and the incentives for improving grade point averages. In particular, it should encourage students to progress and complete their studies. It may also encourage students to undertake courses that are more likely to lead to positive employment outcomes.

Can the rest of the world adopt ‘American’ graduate schools?

We now consider the issue of reinforcing the top of our tertiary education systems, by fostering the internationalization of research universities and their specialization. This is because it has become a commonplace to argue that we need to foster academic R&D and the internationalization of universities, namely by promoting student mobility and university networks able to foster attractive and competitive research and learning environments and to attract and train highly qualified human resources. The key issue is the creation of the conditions able to strengthen institutions and the necessary critical masses to compete at the highest international level. The discussion can be oriented along two different lines (Conceição and Heitor, 2005).

First, the debate has confirmed that the progress of scientific and technological knowledge is a cumulative process, depending in the long run on the widespread disclosure of new findings. For example, David (2007) has systematically shown that:

…open science is properly regarded as uniquely well suited to the goal of maximising the rate of growth of the stock of reliable knowledge.

As a result, universities should behave as ‘open science’ institutions and provide an alternative to the intellectual property approach to dealing with difficult problems in the allocation of resources for the production and distribution of information. Consequently, the main challenge for public policies is to keep the proper balance between open science and commercially oriented R&D based upon proprietary information. At what level should governments foster cooperative exploratory research, which is recognized to be vital for the sustainability of knowledge-driven economies, in reaction to the increasing demand from individuals, research units and private firms for incentives for non-cooperative, rivalry knowledge?

Secondly, worldwide, graduate schools have progressively developed over the past decade in various ways, ranging from interdisciplinary structures based in a single university (thus, closely resembling the US model), to subject-specific inter-university structures. In general, they aim to provide a better link between research training and research strengths and, in a few cases, have provided flexible structures to attract and contract researchers and graduate students in a way far beyond that provided in traditional university departments. But, how far do we need to rely on structures beyond traditional departments in order to promote research universities? And how can we ensure that graduate schools enhance the employability of their graduates? Are the skills transferable? And how is quality assurance ensured?

Regarding Portuguese tertiary education, it should be noted that by the time the necessary legal changes were made, the Portuguese government has promoted its ‘Commitment to Science’ (Gago and Heitor, 2007), fostering public and private investment in S&T, including a large programme of international partnerships with leading institutions worldwide. Scientific output in Portugal increased by 18% over the last two years when measured in terms of the number of scientific papers published in international scientific journals (as quantified by the ISI). A strategic programme of ‘Partnerships for the Future’ was initiated in 2006 and by September 2007 the first doctoral and advanced studies programmes were officially launched, bringing together several Portuguese universities and leading universities worldwide, including: MIT, Carnegie Mellon University and the University of Texas at Austin. Unprecedented in Portugal, these programmes facilitated the creation in 2007 of effective thematic networks of S&T involving a large set of Portuguese institutions in collaboration with companies and internationally renowned institutions.

The overall goal is to facilitate a long-term strategy to strengthen the country’s knowledge base, to foster economic growth and to enhance the quality of life in Portugal, by promoting the strategic coordination of public and private investments to explore international cooperation and industry–science relationships with leading institutions worldwide, in order to sustain strategic investments in people, knowledge and ideas.
In this respect, and following some of the issues raised by Ziman (1968) and also noted by the Nobel Laureate Richard Ernst (2003), one critically important and emerging institutional issue refers to the training of students and young scientists in order to provide them with core competencies that help them to become successful researchers and to prepare them with adequate ‘transferable skills’ for the job market outside research and academia.

**Improving the substance of learning and teaching**

The global landscape, the challenges facing higher education in Europe, and low levels of public expenditures on R&D underscore the need to engage in further higher education reforms within Europe and to address the S&T challenges, particularly in the context of the ongoing Bologna process. So far, efforts at reform do appear to be leading to some successes. Even though the Bologna process is voluntary, most institutions recognize the great challenges and opportunities facing higher education in Europe and have been making efforts to incorporate Bologna issues into their specific institutional strategies and activities. Furthermore, most institutions view the Bologna process as an opportunity to address many of the problems that have long existed in Europe. There are, however, challenges that still remain in this reform movement to adapt higher education in Europe to the global landscape and to improve funding for R&D. Understanding the relationship between Bologna reforms and the social and national contexts in which they take place and expanding the European policy dialogue in higher education to include more issues, remain significant challenges in the current process.

Within this debate, the need to foster the internationalization of universities is emerging, either in terms of promoting student mobility or, above all, European university networks able to foster attractive and competitive research and learning environments and to attract and train highly qualified human resources. The key issue is the creation of international partnerships able to strengthen institutions and the necessary critical masses to compete at the highest international levels and, at the same time, guarantee an adequate level of institutional integrity for the university.

But, overall, changing the patterns of teaching and learning, promoting active (less passive) work by the students themselves and fostering student-centred education schemes are our ultimate goals. We need to allow students to determine their own learning paths and trajectories, namely along education cycles, but also across institutions in our different regions and countries.

The debate requires TEIs, at large, to better understand ‘how people learn’. It is clear that learning systems vary considerably across the full spectrum of disciplines, with arts and medicine leading project-based approaches and, probably, engineering and the social sciences following a rather intense ‘academic drift’. But if the ultimate goal is to enhance participation rates and the recruitment base of tertiary education, we believe the debate will gain from the current knowledge of basic and secondary education levels.

The work done by the US National Research Council (2000) on ‘How People Learn’ provides clear evidence that ‘designing effective learning environments includes considering the goals for learning and goals for students’. Given the many changes in student populations, tools of technology, and society’s requirements, different curricula have emerged along with needs for new pedagogical approaches that are more student-centred and more culturally sensitive. The requirements for teachers to meet such a diversity of challenges also illustrates why assessment needs to be a tool to help teachers determine whether or not they have achieved their objectives. But supportive learning environments, namely fostering a culture of beliefs in science, need to focus on the characteristics of classroom environments that affect learning. In this respect, the above authors were referring not only to the social and organizational structures in which students and teachers operate, including the environments created by teachers, but also to the learning environments beyond school.

The idea that science should be considered as an open system, with different and diversified ways of participation, is mainly derived from the fact that scientific activity is increasingly part of people’s lives, so that the training of scientists should not be closed to a specific group of people, but should rather be a broad action and part of today’s education. In this context, it has become clear that the renewal of education systems has been particularly influenced by constructivism (Bennett, 2003). Following Piaget’s (1973) view of knowledge construction by using ‘active methods which require that every new truth to be learned, be rediscovered or at least reconstructed by the student’, Papert (1991) added the idea that knowledge construction ‘happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity’. And this is because “without knowledge, practice is limited and without practice, knowledge will never be fully realized” (Reeve and Rottondi, 1997). This constructionism viewpoint facilitates the ‘new milieu of discovery, learning, and sharing’ mentioned above, and experience suggests that it allows institutions to:

- expose students to a multidisciplinary design experience;
- prompt participants to think about systems architecture;
- raise issues of organizational processes in a technical context;
Following the practices, skills, attitudes and values described above, education at all levels must consider that learning a new practice requires moving through discovery, invention, and production not once, but many times, in different contexts and different combinations (European Commission, 2007).

To achieve these objectives, we must learn from new research and, certainly, we also need to foster evidence-based, project and experimental work, as well as to focus our attention on the transferable skills students should acquire. But we also need to reduce drop-out (failure) rates in tertiary education and to involve students in research activities from their early stages at our institutions. In summary, we need to go beyond the structure of tertiary education and gradually concentrate our efforts in measuring and taking stock of the diversity and evolution of concrete student-centred parameters.

In addition, more diversified systems are required and this has led much of the current reform in Portugal, which is promoting a ‘binary system’ of tertiary education, with polytechnic education concentrating upon professionally oriented and vocational training, while the universities are further concentrating on postgraduate education.

Non-university tertiary institutions are seen in many countries as nearer to the labour market and the more flexible arm of higher education. But, how can we identify labour market needs and how can we provide the necessary skills, qualifications and technical know-how? Are non-university institutions more regionally specific institutions and consequently better able to detect the needs of local industry and promote local and regional innovation clusters?

To a large extent, these question remain to be solved. We also need to increase the number of adult (i.e. those over 23 years of age) students in tertiary education by removing barriers to their entrance and success with due attention to their social and economic roots. This certainly reinforces the need for diversified systems of tertiary education, leading to greater differences in the learning and teaching systems in professionally oriented and science-driven programmes.

In Portugal, regulations that aim to bring tertiary education in line with the Bologna process were implemented very successfully, including the opening of higher education to new publics and the development of post-secondary education through the polytechnic sub-system: (i) In the 2008–2009 academic year, about 98% of initial training courses that opened places were already organized in accordance with the Bologna process principles (it was about 90% in 2007–2008). (ii) The opening of higher education to new publics through the new access regime for adults resulted in the number of individuals entering tertiary education by this means rising to roughly 11,750 in 2007–2008 and 10,850 in the 2006–2007 academic years, up from around just 900 adults that started in tertiary education in the 2005–2006 academic year. (iii) In 2008, a total of 190 short, post-secondary degree programmes administered in institutions of higher education has been reached, involving more than 4000 admitted students.

It is clear that we need to foster institutions that take absolute care of emerging scientific and technological developments, but which also pay attention to societal changes and the continuous alterations of the labour market. But we also need to look beyond our own institutions of higher education and monitor the employability of students along the various education cycles. A new observation system was launched in Portugal in 2007 to steer student demand through the publication, twice a year, of information regarding graduate job seekers registered at employment centres. In addition, under the new Higher Education Act, TEIs are required to collect and publish annual information on the employment/career experiences of their graduates for up to five years after graduation.

Certainly we need to harmonize quality assurance systems and we fully support the implementation, in Europe, of the new Register for Agencies of Accreditation and Evaluation across Europe.

**Strengthening institutions and systems linkages, as well as institutional autonomy and integrity**

We need to preserve the institutional integrity of TEIs, at the same time we need to promote dynamic and responsive institutions, by widening the scope of diversity and of institutional autonomy, while ensuring effective accountability (Conceição and Heitor, 1999, 2007).

The above analysis stresses the relevance and opportunity of the emerging modernizing agenda for higher education in Europe and, in particular, of research universities. But, again, reference terms require clarification, namely in terms of the perception in many European constituencies of the reality of American universities regarding knowledge production and diffusion. Many authors over the last two decades (Pavitt, 1987; Rosenberg and Nelson, 1996) have argued that whatever does not harm the institutional integrity of the university is acceptable. Companies and universities have evolved in a social context, to the point of attaining what these authors have termed ‘institutional speciality’. Thus, whereas companies are concerned to obtain private returns for the knowledge that they generate, universities have traditionally made it public. By means of this specialization, or ‘division of labour’, the accumulation of knowledge has taken place at a rapid pace, as is shown by the unprecedented levels of economic growth since the end of the Second World War.

This argument can be analysed in detail, in the context of knowledge-based economies (Oliveira et
The threats to a university’s institutional integrity in fact go beyond the extension of its activities to links with society, which, if excessive, could lead to resources being spread too thinly. This analysis is based on the more serious problems that may arise if TEIs take the path of privatizing the ideas that they produce and the skills that they develop.

We may begin by analysing the higher education function of teaching, which contributes to the accumulation of knowledge, specifically of skills, through the formal process of learning through education, or ‘learning by learning’. This process is divergent (Conceição and Heitor, 1999): a university education combines the transmission of codified knowledge by the teachers with the individual characteristics of the students, in a process in which the interpretation of ideas leads to the accumulation of unique skills. Given this situation, each student can profit from these skills in the future. The university may therefore be tempted to increase the direct price to the students of their education, as a way of increasing its income.

Besides the well-known externalities associated with higher education, which justify state support for education in virtually every country in the world with the possible exception of Japan, analysis of the need to provide the skills necessary for the information society in which we live strengthens the arguments in favour of state support for higher education. The threat of increased privatization of teaching skills could thus cause serious problems, in that it would lead to a reduction in the resource that really is in short supply in the knowledge-based economies: the skills to use and interpret ideas. This conclusion does not cast doubt on the contributions currently made by students, but rather questions a possible trend that could jeopardize the institutional integrity of the university itself, if the tendency to reduce public funding persists in many countries.

In terms of research, it is worth noting that the great majority of the ideas that are generated in universities are of a public nature, this being the essence of the specific contribution that the university makes to the accumulation of ideas. Incentives for the production of these public ideas come from a complex system of reward and prestige within the academic community. In a well-known survey of university teachers in the late 1990s in the US, the most satisfying factor, chosen by 86.2% of the sample, was autonomy and independence (University of California at Los Angeles, 1997). Again, the temptation to privatize university research results could threaten fundamental aspects of the way universities work and their essential contribution to the accumulation of ideas.

To summarize, our conclusion is that the institutional integrity of TEIs should be preserved, and an important point in terms of public policy is that state funding of TEIs should not be reduced. However, this measure by itself is not enough. From a more pragmatic viewpoint, TEIs should respond to the needs of society, which include rapid and unforeseeable changes in the structure of the employment market and the need to furnish its graduates with new skills beyond purely technical ones, in particular learning skills. The need to promote dynamic and responsive TEIs leads us to consider widening the scope of diversity and of institutional autonomy, while ensuring effective accountability. Again, the institutional integrity of the TEIs must always be preserved, at the same time new forms of knowledge production (namely in the way presented since the early 1990s by Gibbons et al. (1994)) should be considered in reforming TEIs and their links with society.

A diversified system presents advantages as it relates to research integrity. Analysing the function of university research actually includes various subfunctions, not always clearly defined, but which should be the subject of distinct public policies and forms of management, as follows:

- R&D which aims at the accumulation of ideas through convergent learning processes, which are associated with processes of knowledge codification. This is the commonest form of research, particularly in the context of economic development and from the standpoint of the relationship between universities and companies.
- R&T (research and teaching) in which research functions as a way of developing teaching materials, as well as of improving the teaching skills of the teaching staff, and which is also associated with convergent processes of knowledge codification.
- R&L (research and learning) in which the value of the research is not necessarily in the creation of ideas, but in the development of skills that enhance opportunities for learning. Research thus appears as a divergent function, associated with processes of interpretation.

According to the analysis by Conceição and Heitor (1999) and although the various subfunctions listed above are strongly interconnected, R&D and R&T are related to the creation of ideas. In this context, selectivity is required in the choice of individuals with suitable skills for these types of activity. In turn, R&L is associated with a learning process, which seeks to develop learning skills through the experience of doing research.

In these circumstances a diversified system could respond effectively to the different demands made on it in the emerging economy, by being selective in R&D and R&T, and comprehensive in R&L. Indeed, in the context of the knowledge economy, the comprehensive nature of R&T should be extended beyond the university to cover the whole education system, as a way of promoting learning skills. In this situation, it seems essential to place renewed emphasis on education and, to a certain extent, to reinvent its social and economic role. Educational institutions must rethink their relationships with the individuals, families and communities among which...
they find themselves, presenting themselves as vital providers of opportunities to develop formal learning processes, while at the same time encouraging a way of life that promotes learning through social interaction.

To sum up, rather than presenting a detailed plan of public policy options and forms of management for higher education, we have addressed in the paragraphs above how the concepts developed in the literature can be used to analyse the challenges facing the research integrity of the university in the knowledge-based economy, and what kind of opportunities can be discerned. Among our substantive conclusions are: the importance of preserving the institutional integrity of TEIs, not only by avoiding excessive dissipation of their resources in activities related to their links with society, but most importantly by maintaining the academic character of their basic functions of teaching and research. In a situation in which education should promote learning skills, we put forward the need to identify and understand the different components of university research, so as to enhance the selectivity of the R&D and R&T subfunctions, while ensuring the widespread availability of R&L. It is argued that a diversified higher education system can free the universities from many of the pressures that they are experiencing today, by helping to ensure the preservation of their institutional integrity.

The analysis shows, in the particular case of the university, that preservation of its institutional integrity is essential in a situation of sustained flexibility, in which education, besides offering a specific qualification, should ensure the assimilation of learning skills. The signs of the knowledge economy, notably the expansion in university education and the need to manage multiple demands and to ensure participative learning, point towards a diversification of the system, with reference to which it is particularly important to identify and understand the different components of the university’s research function.

The question arises as to how far universities can sustain their own independence and support integrity in research. As the Nobel Laureate Richard Ernst (2003) has said:

> Universities should consider themselves as cultural centers with far-reaching radiance rather than merely serving as training grounds for academic specialists. The integration of knowledge, perception, and comprehension, as well as compassion, is at least as relevant as extreme specialization. Obviously, scientific excellence is indispensable, but insufficient in isolation.

This leads us to better understand how far university networks can effectively contribute to fostering basic university goals and preserving research integrity. In fact, many research universities have developed into new and innovative institutions, both national and international in scope, organized as consortia and combining in their open structures teaching, research, business incubators, culture and services. As universities develop new institutional capacities further challenges emerge. In particular, most universities are faced with the need to increase and diversify their sources of funding, as well as with increasing leadership and management functions.

In recent years a number of European universities have created clusters and associations driven by student exchange programmes and growing research opportunities (see Table 1). These clusters have been particularly focused on corporate matters and we argue that there is a need for a platform for the various clusters and associations of research universities, notably for stimulating the political debate among the various stakeholders at international level and for assisting in the networking of national constituencies which foster integrity in higher education.

TEIs are under pressure to reform as a result of increasing global challenges. The relationship between universities and governments, their main source of funding and their governing authority in most cases, remains an uneasy one and often, does not reflect the realities of an evolving political, social and economic environment. Multiple objectives should not be pursued at the cost of compromising learning and research environments for students, which also require continuous adaptation and improvements (e.g. in the new context of the Bologna process in Europe).

Finally, the legal status of TEIs should be noted, because we have seen, especially in Continental Europe, that raising the level of autonomy for TEIs, is one of the main objectives of sector reforms across different countries in recent years. Granting independent legal status to TEIs is one means of achieving this goal: it gives TEIs greater autonomy to govern themselves and function as they see most appropriate, in a free and independent way, in pursuit of work that is deemed essential to society.²

In addition, recognizing scientific knowledge as a ‘public good’ introduces the need to consider new policy dimensions in S&T policy that are designed and implemented in a way that fosters independent scientific institutions, among which the way in which transnational institutions are organized may provide a useful framework.

It is in this context, and again taking the case of Portugal, that the new Legal Regime of Higher Education Institutions approved by the Portuguese Parliament in September 2007 established the organizational principles of the higher education system: the autonomy and accountability of institutions, setting up governing boards with external participation, diversity of organization and legal status of public institutions, namely as private foundations, establishment of consortia, recognition of research centres as part of the university management framework.
If any conclusion can now be drawn, it is that there is a consensus about the need, and the opportunity, to accelerate reform of TEIs in order not only to stimulate progress across the whole tertiary education system, but also to foster the emergence and strengthening of those institutions which can demonstrate their excellence at international level. But accelerating reform requires the need to concentrate tertiary education reform on a myriad of issues that will ultimately open the ‘black box’ associated with all type of institutions, preserving autonomy while building up a new set of relationships with society at large and introducing an ‘intelligent accountability’ associated with a renewed structure of incentives.

To cope with such a variety of demands and with a continuously changing environment, we all know that the tertiary education system, in particular, needs to be diversified. But the challenge of establishing modern tertiary education systems requires effective networks and a platform of research institutions, notably for stimulating the political debate among the various stakeholders and for assisting in the networking of national constituencies promoting the positioning of our institutions in the emerging paths of brain circulation worldwide.

And this must be achieved in a way that will promote new leaderships for our institutions. Attention has been drawn to the need to promote an international market of excellence for university leaders, and also a critical path to attract our best researchers to take the leadership of our universities (Goodall, 2006).

I would also argue that strengthening external societal links and ‘system linkages’ are critical in making the institutional changes required to meet the needs of global competition and the knowledge economy. They consider, among others, public and private research organizations for universities and regional and business links associated with vocational training institutions.

This issue was particularly discussed in the context of the European Union by the High Level Group on Human Resources for Science and Technology appointed by the European Commission (2004), either in terms of renewing science education, or creating science culture, and we would wish to reinforce this argument, as follows.

The need to better explain to the society at large the realizations of the academic and scientific

### Table 1. Sample networks and clusters of research universities in Europe

<table>
<thead>
<tr>
<th>LERU (League of European Research Universities) (see also <a href="http://www.leru.org/">http://www.leru.org/</a>)</th>
<th>IDEA League (see also <a href="http://www.idealeague.org/">http://www.idealeague.org/</a>)</th>
<th>CLUSTER (Consortium Linking Universities of Science and Technology for Education and Research) (see also <a href="http://www.cluster.org/">http://www.cluster.org/</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Cambridge</td>
<td>Imperial College London</td>
<td>Imperial College London</td>
</tr>
<tr>
<td>Universiteit van Amsterdam</td>
<td>TU Delft</td>
<td>Technische Universiteit Eindhoven</td>
</tr>
<tr>
<td>University of Geneva</td>
<td>ETH Zurich</td>
<td>Ecole Polytechnique Fédéral de Lausanne (EPFL)</td>
</tr>
<tr>
<td>Albert-Ludwigs-Universität Freiburg</td>
<td>RWTH Aachen University</td>
<td>Technische Universität Darmstadt</td>
</tr>
<tr>
<td>University of Edinburgh</td>
<td>ParisTech</td>
<td>Institut National Polytechnique de Grenoble</td>
</tr>
<tr>
<td>Ruprecht-Karls-Universität Heidelberg (University of Heidelberg)</td>
<td></td>
<td>Universität Karlsruhe (TH)</td>
</tr>
<tr>
<td>University of Helsinki</td>
<td></td>
<td>Helsinki University of Technology</td>
</tr>
<tr>
<td>Leiden University</td>
<td></td>
<td>Technical University of Catalonia, Barcelona</td>
</tr>
<tr>
<td>Katholieke Universiteit Leuven</td>
<td></td>
<td>Université catholique de Louvain</td>
</tr>
<tr>
<td>University College London</td>
<td></td>
<td>Instituto Superior Técnico, Lisbon</td>
</tr>
<tr>
<td>Lunds Universitet</td>
<td></td>
<td>Kungliga Tek. Högskolan, Stockholm</td>
</tr>
<tr>
<td>Università degli Studi di Milano (University of Milan)</td>
<td></td>
<td>Politecnico di Torino</td>
</tr>
<tr>
<td>Ludwig-Maximilians-Universität München (LMU Munich)</td>
<td></td>
<td>Georgia Institute of Technology, Atlanta</td>
</tr>
<tr>
<td>University of Oxford</td>
<td></td>
<td>Tsingua University Beijing</td>
</tr>
<tr>
<td>Université Pierre et Marie Curie, Paris 6</td>
<td></td>
<td>Ecole Polytechnique de Montréal</td>
</tr>
<tr>
<td>Université Paris-Sud 11</td>
<td></td>
<td>Tomsk Polytechnic University</td>
</tr>
<tr>
<td>Karolinska Institutet, Stockholm</td>
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<tr>
<td>Université Louis Pasteur Strasbourg</td>
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<tr>
<td>Universiteit Utrecht</td>
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<tr>
<td>Universität Zürich</td>
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</tbody>
</table>

### Conclusions

If any conclusion can now be drawn, it is that there is a consensus about the need, and the opportunity, to accelerate reform of TEIs in order not only to stimulate progress across the whole tertiary education system, but also to foster the emergence and strengthening of those institutions which can demonstrate their excellence at international level. But accelerating reform requires the need to concentrate tertiary education reform on a myriad of issues that will ultimately open the ‘black box’ associated with all type of institutions, preserving autonomy while building up a new set of relationships with society at large and introducing an ‘intelligent accountability’ associated with a renewed structure of incentives.
communities and to foster the public understanding of science and of the role of TEIs in scientific and technical development, where schools and other institutional settings (e.g. science museums) have a determining role in stimulating curiosity and the interest for scientific knowledge. In this regard, the European report by Miller et al. (2002) clearly acknowledges the leading role of national programs such as La Main a la Pate in France, or the Ciência Viva program implemented in Portugal since 1996, but also recognizes the still difficult climate for promoting science (and knowledge) culture in Europe. The continued implementation of actions fostering ‘science for all’ is a practice to follow, where the concept of ‘knowledge integrated communities’ appears particularly suitable to facilitate the joint enrolment of researchers, TEIs and basic and secondary schools in specific projects driving society at large. It is clear that this requires new knowledge about social behaviours, as well as new methodological developments, and the work edited by Solomon and Gago (1994) still provides important guidelines to help move towards a knowledge society in a fast moving landscape. The objective is to integrate systems of knowledge and ways of practising, where schools interact with TEIs in systematic ways, building routines of cooperative work.

To conclude, by focusing governmental and political actions on the external dimension, TEIs are asked to strengthen their capacity to make the critical internal changes for modernizing their systems of teaching and research within a path of diversity and specialization, without compromising quality. Furthermore, by enhancing their external links with society at large, TEIs are asked to carefully improve their relationships with economic, social and political actors, thereby creating ‘new’ reinforced institutions that have gained societal trust.

Notes
1. This follows the seminal work by Nicholas Barr, as published in Barr (2004), see also Barr and Crawford (2005).
2. See, for example, the discussion on the emerging ‘meta-university’ by Vest (2007).
3. For a detailed comparative analysis, see Hasan (2007).

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