A system approach to tertiary education institutions towards knowledge networks and enhanced societal trust[1]

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Abstract

I argue in this paper 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 tertiary education institutions to strengthen their capacity to make the critical internal changes for modernising their systems of teaching and research within a path of diversity and specialisation, without compromising quality. Furthermore, by strengthening their institutional integrity together with enhancing their external links with society, tertiary education institutions 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.

1. Introduction

Tertiary education systems are under pressure to meet demands imposed by a globalised 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 have emerged directly conducted by governments in many different countries and

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political regimes. The Portuguese system is no exception to these mounting pressures and change has been recently introduced through governmental actions[2].

As a starting point[3], we must recognize that scientific progress is a source of development and that tertiary education institutions 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[4].

Some forty years after John Ziman launched the discussion on *Public Knowledge*[5] and thirty years after his work on *Reliable Knowledge*[6], to appreciate the significance of scientific knowledge one must understand the nature of science as a complex whole. In *Real Science*[7], we are reminded that "science is social", referring 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 upon strong conviction not only from the scientific and technical professions and of 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 discussed in this paper.

It is under 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 mix set of public and private incentives[8]. Moreover, the long history of past investments and current division of labor or specialization cannot be replicated in systems with a lower scale and complexity. The key elements of the US history are

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[2] Gago, J.M. and Heitor, M. (2007), "A commitment to science for the future of Portugal", in J.M.Gago, ed., "The Future of Science and Technology in Europe", Portuguese Ministry of Science, Technology and Higher Education.

3 See, for example, Conceição, P. and Heitor, M. V. (1999). "On the Role of the University in the Knowledge Economy", Science and Public Policy, 26(1), pp. 37-51.

4 See, for example, European Commission (2004). Increasing human resources for science and technology in Europe. Eds., Gago, J., Ziman, J., Caro, P., Constantinou, C., Davies, G., Parchmannn, I., Rannikmäe, M. and Sjøberg, S.; High Level Group on Human Resources for Science and Technology, European Commission.

[5] Ziman, J. (1968), Public Knowledge: The Social Dimension of Science, Cambridge University Press

[6] Ziman, J. (1978), Reliable Knowledge: an exploration of the grounds for belief in science, Cambridge University Press

[7] Ziman, J. (2000), Real Science: What it is, and what it means, Cambridge University Press

[8] P. Conceição, M. V. Heitor, G. Sirilli and R. Wilson (2004), "The Swing of the Pendulum from Public to Market Support for Science and Technology: Is the US Leading the Way?", Technological Forecasting and Social Change, 71(5), pp. 553-578.

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.

The same way the US S&T system as a whole is taken as a worldwide reference, the US university system is also used as a role model for its fast rate of responsiveness to the economic changes and contribution to the creation of wealth[9]. The understanding, mainly by European counterparts[10], that the universities are gradually viewed as important engines of economic growth and development instead of mere institutions of higher education learning is evident for many years[11], as there is increasing evidence of their importance as developers of regional industrial and technological development[12]. This is a role that US universities, and especially research universities, have assumed throughout the second half of the 20th century[13].

Here, too, as with the whole US system, there is the perception that private funding associated to a high level of industry-science relationships is very high and stimulates a very dynamic academia, which contributes in a much more direct and with bigger impact to the social economic development at both regional and national level. The possibility of getting funding from private sources and private incentives (such as Intellectual Property Rights, IPRs) is also very appealing for the European universities that strive with increasing demands for change and for being more closely engaged with society.

At a time that they have increasing financial difficulties, derived from public budgets constrains, 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[14]. However, this perception is leading to an <u>institutional convergence</u> between what universities do (and are supposed to do) and what firms and other

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[9] National Academy of Engineering (NAE) (2003) *The Impact of Academic Research on Industrial Performance*, Washington, NAE Press.
[10] European Commission, The role of the universities in the Europe of Knowledge, COM(2003) 58 final: http://europa.eu.int/comm/education/doc/official/keydoc/2003/univ_en.pdf
[11] See, for example, Saxenian, A (1986), "Regional Advantage: Culture and Competition in Silicon Valley and Route 128", London, Harvard University Press.
[12] See, for example, the original work of Cooke, P., and Huggins, R., University-Industry Relations in Wales. Working Paper, Center for Advanced Studies in the Social Sciences, UWCC, 1996.
[13] Rosenberg, N., (2002) "Knowledge and Innovation for Economic Development: Should Universities be Economic Institutions?" in Conceição, P, Gibson, D.V., Heitor, M.V., Sirilli, G., and Veloso, F., *Knowledge for Inclusive Development*, Westport, Quorum.
[14] See, for example, the original considerations by Neave, G. (1995), "The stirring of the prince and the silence of the lambs: the changing assumptions beneath higher education policy, reform and society" in Dill, D.D. and Sporn, B. (Eds) *Emerging Patterns of Social Demand and University Reform: Through a Glass Darkly*. Oxford, Pergamon.

agents do. In fact, more than a decade after Burton Clark launched the idea of "Entrepreneurial Universities"[15], much remains to learn about their impact and analysis[16] has 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[17].

Above all, we follow Charles Vest[18], former MIT´s President, in his most recent book in 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 willing not 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 be detrimental to the global production of knowledge, but also certainly would harm the development prospects of Europe itself, namely in comparison with the US.

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

For the purposes of this paper, we will use sample examples of the current Portuguese reform of tertiary education in order to illustrate our main arguments. This is because over a year 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 throughput legal reform of the Portuguese tertiary education system was completed[19]. It considers significant changes in the internal system of governance of HEI´s

[15] Clark, B. R. (1998), "Creating Entrepreneurial University. Organizational Pathways of Transformation. Oxford, Pergamon Press.
[16] Conceição, P. and Heitor, M. V. (1999). "On the Role of the University in the Knowledge Economy", Science and Public Policy, 26(1), pp. 37-51.
[17] Nelson, R.R., (2004) "The market economy, and the scientific commons", *Research Policy* 33 (2004) 455-471.
[18] Vest, C.M. (2007), "The American Research University – from World War II to World Wide Web: Governments, the Private Sector and the emerging Meta-University", University of California Press.
[19] OECD (2007), Review of National Systems of Tertiary Education – Portugal, OECD.

(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 science and technology.

The remaining of this paper is focused on four selected and interrelated issues, which are considered to be central to understanding the knowledge dimension and external societal links of tertiary education institutions, namely: i) improved funding and equity for enlarged participation rates; ii) strengthening knowledge production and internalization for improved knowledge networks; iii) fostering diversified systems for improved knowledge transmission and learning; and iv) strengthening institutional integrity together with systems linkages. The paper concludes with a summarizing session addressing the overall need to strengthen societal trust on tertiary education institutions.

2. How to promote enlarged participation rates?...new funding schemes for improved equity in access!

Let me start by the need to open-up tertiary education worldwide by strengthening the "bottom of the pyramid". In fact, our underlined 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[20]. 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. As a result, increased diversified systems are required, as discussed later in this paper.

But it is also clear that the need to modernise funding mechanisms and ensure a better balance between institutional and competitive funding for tertiary education is leading the discussion in governments worldwide[21]. It appears that more important than discussing the details of funding formulas for institutional funding mechanisms, it is to review the overall share of institutional and competitive funding sources, as well

[20] This follows the seminal work of Nicholas Barr, as published in Barr, N. (2004), "Higher Education Funding", Oxford Review of Economic Policy, 20 (2), pp. 264-283. See, also, N. Barr and I. Crawford (2005), "*Financing Higher Education: answers from the UK*", Routledge.

[21] Conceição, P., Heitor, M. V. and Veloso, F. (2003). "Infrastructures, Incentives and Institutions: Fostering Distributed Knowledge Bases for the Learning Society", Technological Forecasting and Social Change, 70(7), pp. 583-617.

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 recently argued by Paul David and Sten Metcalfe, increased competition and collaborative patterns among funding agencies at an international level[22]. 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 among 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 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 science and technology, as well as enhanced risk management tools that are as important aspects of "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 for attracting 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, namely at tertiary education institutions. Nicholas Barr[23] keeps remembering us that the goal is to provide free education to all **students**, by guaranteeing **graduates** to share the costs. The question is that the correct amount to be shared among the tax

22 See also, David, P. and Metcalfe, S. (2007), "Universities and Public Research organizations in the ERA", prepared for the EC (DG-Research) Expert Group on "Knowledge and Growth", June 2007.

23 Nicholas Barr (2008), "Lessons learned from UK´s Higher Education Funding schemes", International Conference on "Increasing accessibility to higher education - Some international examples on student loans", University of Lisbon, 2nd June.

payer and graduates, as well as other private sources, is still to be shown (at least using scientific grounds…), relying very much in the socio-political grounds!

Although income-contingent loan systems are becoming a typical reference worldwide, as clearly acknowledge by the OECD, it should be noted that their applicability is particularly dependent on the characteristic of the existing fiscal system. This is why we have introduced last Autumn in Portugal an innovative system of student loans with mutual guarantee underwritten by the State, which complements the system of public grants, thereby improving access to higher education for all students. About 3000 loans have been contracted in the first six months through the banking system and this represents an important new achievement for Portugal and the Portuguese families, which follows current practices in modern societies at the OECD level.

Following Michael Gallagher[24], "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". Still regarding the new Portuguese Loan System, Nick Barr[25] has recently "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 their studies and complete their awards, and it may encourage students to undertake courses that are more likely to lead to positive employment outcomes.

[24] Michael Gallagher, March 2008, personal note.
[25] Nick Barr, June 2008, personal note.

3. Fostering academic research and internalization: how to strengthen knowledge production for improved knowledge networks?

Let me turn now to 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 common place to argue that we need to foster academic R&D and the internationalisation 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[26]. 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 in two different lines of discussion[27].

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, Paul David[28] 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?

Second, at the institutional level, *Graduate Schools* have been developed progressively worldwide over the past decade in diversified ways, ranging from interdisciplinary structures and based in a single university (thus, closely resembling the US model), to subject-specific inter-university structures. In general they aim to

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[26] See, for example, the discussion on the emerging "meta-university" by Vest, C.M. (2007), "The American Research University – from World War II to World Wide Web: Governments, the Private Sector and the emerging Meta-University", University of California Press.

[27] For a more detailed discussion, see P. Conceição, M. V. Heitor, (2005), "*Innovation for All? Learning from the Portuguese path to technical change and the dynamics of innovation*". Westport and London: Praeger.

[28] See, among others, Paul David (2007), "The historical origin of 'open science' - An Essay on Patronage, Reputation and Common Agency Contracting in the Scientific Revolution", Stanford Institute for Economic Policy Research, June.

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 in structures beyond traditional departments in order to promote research universities? And, how to ensure that graduate schools permit better employability of their graduates? Can the skills be transferable? And how is quality assurance ensured?

Regarding the Portuguese tertiary education, let me note that by the time the necessary legal changes were made, the Portuguese government has promoted its "Commitment to Science"[29], fostering public and private investment in science and technology, including a large program 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 publications internationally referenced. 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 science and technology 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 a way to sustain strategic investments in people, knowledge and ideas.

In this respect, and following some of the issues raised by John Ziman[30] many years ago and also noted by Nobel Laureate Richard Ernst (2003)[31], 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

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[29] Gago, J.M. and Heitor, M. (2007), "A commitment to science for the future of Portugal", in J.M.Gago, ed., "The Future of Science and Technology in Europe", Portuguese Ministry of Science, Technology and Higher Education.
[30] Ziman, J. (1968), "*Public Knowledge: The Social Dimension of Science"*, Cambridge University Press
[31] Ernst, R. (2003), "The Responsibility of Scientists, a European View", Angew. Chem. Int. Ed. 2003, 42, pp. 4434 –4439.

successful researchers and prepare them with the adequate “transferable skills” for the job market outside research and academia.

4. How to improve the substance of learning and teaching? ...what do we need to know?

Let me move to learning and teaching and the current debate in Europe. In fact, 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, to address the science and technology challenges, particularly in the context of the ongoing Bologna process. So far, reform efforts 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 internationalisation 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 level and, at the same time, guarantee the adequate level of institutional integrity of 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 tertiary education institutions, 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 enlarge participation rates and the recruitment base of tertiary education, we believe the debate will gain from current knowledge of basic and secondary education levels, as follows.

The US´s National Academies effort on "How People Learn"[32] 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 child-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 if 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 aspect, the authors were referring to the social and organizational structures in which students and teachers operate, including the environments created by teachers, but also the learning environments out of school.

The idea that science should be considered as an open system, with different and diversified ways of participation, mainly derived from the fact that scientific activity in increasingly part of people's live, so that the training of scientists should not be closed to a specific group of people, but rather a broad action and part of today's education. Under this context, it has become clear that the renewal of education systems has been particularly influenced by constructivism[33]. Following Piaget's (1973)[34] 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", Seymour Papert (1991)[35] added the idea that the 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,

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[32] National Research Council (2000), "How People Learn: Brain, Mind, Experience and School", J.D. Bransford, A.L. Brown and R.R. Cocking, Eds., Committee on Developments in the Science of learning, Commission on Behavioral and Social Sciences and Education, National Research Council, Washington, D.C.

33 Bennett, J. (2003). Teaching and Learning Science: A Guide to Recent Research and its Applications. London: Continuum.

34 Piaget, J. (1973). To Understand is to Invent: The Future of Education. New York: Grossman Publishers.

[35] Papert, S. (1991). "Situating Constructionism", in Harel, I. and Papert, S. (eds.), Constructionism, pp. 1-11. Norwood, NJ: Ablex Publishing.

practice is limited and without practice, knowledge will never be fully realized"[36]. This constructionism viewpoint facilitates the "new milieu of discovery, learning, and sharing" mentioned above, and leading experiences suggest that it allows to:

- Expose students to a multi-disciplinary design experience;
- Prompt participants to think about systems architecture;
- Raise issues of organizational processes in a technical context;
- Built learning communities of students, faculty, and staff.

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[37].

To achieve these objectives, we must learn form 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 since 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, increased diversified systems are required and this has led much of the current reform in Portugal. It has been driven to promote a "binary system" of tertiary education, with polytechnic education concentrating upon professionally-oriented and vocational training, while university education should be further concentrated 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 to identify labour market needs and how to provide the necessary skills, qualifications and technical know-how? Are non-university institutions more regionally specific institutions and consequently in a better capacity to detect the needs of local industry and promote local and regional clusters of innovation?

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[36] Reeve, M. and Rotondi, M. (1997). From the Center: Design Process at SCI-Arc. New York: The Monacelli Press.

[37] See also European Commission (2007). Science Education now: A renewed pedagogy for the future of Europe. Eds., Rocard, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, H., Hemmo, V.; Directorate-General for Research, Science, Economy and Society, EUR Report 22845, European Commission.

At a large extent, these question remain to be solved and we also need to increase the number of adult students in tertiary education by removing barriers to their entrance and success with due attention to its 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 programs.

In Portugal, the implementation of the full regulation that aims to bring tertiary education in line with the Bologna process was carried 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 2007-2008 school year, about 87% of initial training courses that opened places are already organized in accordance with the Bologna process principles; ii) The opening of Higher Education to new publics through the new access regime for adults (i.e., those over 23 years of age) resulted in the number of individuals entering tertiary education by this means rising to roughly 11,750 in 2007/08 and 10,850 in the 2006-07 school years, up from around just 900 adults that started in tertiary education in the 2005-06 school year; and iii) In 2007, a total of 190 short, post-secondary degree programs ministered in Institutions of Higher Education has been reached, involving more than 4.000 admitted students.

It is also clear that we need to foster institutions that take absolute care of emerging scientific and technological developments, but also to pay attention to societal changes and the continuous alterations of the labour market. But we need also to look beyond our own institutions of higher education and monitor the employability of students along the various education cycles. This is because we have launched in Portugal last year a new observation system to steer student demand through the public divulgation, twice a year, of information regarding graduate job seekers registered in employment centers. In addition, under the new Higher education Act, tertiary education institutions are required to collect and publish annual information on the employment/career experiences of their graduates 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.

5. How to strengthen institutions and systems linkages, together with institutional autonomy and integrity?

My final point is about **the need to preserve 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[38].

This is because the analysis above calls for 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 built in many European constituencies about the reality of American universities regarding knowledge production and diffusion. Many authors over the last two decades[39] argue 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 call "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 specialisation, 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 analyzed in detail, in the context of the knowledge-based economies[40]. 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 higher education institutions take the path of privatising the ideas that they produce and the skills that they develop.

We may begin by analyzing 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

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[38] See Conceição, P. and Heitor, M.V. (2007), "Do we need a revisited policy agenda for research integrity? …an institutional perspective", "World Conference on Research Integrity", Calouste Gulbenkian Foundation, Lisbon, Portugal, 16-18 September 2007. See also, Conceição, P. and Heitor, M.V. (1999), "On the role of the university in the knowledge-based economy". Science and Public Policy, 26 (1), pp. 37-51.

[39] See, for example, Pavitt, K. (1987), "The Objectives of Technology Policy", *Science and Public Policy*, 14, 182-188; Rosenberg, N. and Nelson, R. R. (1996), "The Roles of Universities in the Advance of Industrial Technology", in Rosenbloom, R. S. and Spencer, W. J., *Engines of Innovation*. Cambridge, MA: Harvard Business School Press.

[40] Oliveira, P., Conceição, P. and Heitor, M., 1998. "Expectations for the University in the Age of the Knowledge Based Societies" *Technological Forecasting & Social Change*, 58 (3): 203-214

divergent[41]: 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 favor 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 jeopardise the institutional integrity of the university itself, if the tendency to decrease public funding persists in many countries.

Moving on to 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 nineties in the United States, the most satisfying factor, chosen by 86.2% of the sample, was autonomy and independence[42]. Again, the temptation to privatise university research results could threaten fundamental aspects of the way universities work and their essential contribution to the accumulation of ideas.

To summarise, 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

[41] Conceição, P. and Heitor, M. V. (1999). "On the Role of the University in the Knowledge Economy", *Science and Public Policy*, vol. 26, no. 1, pp. 37-51.
[42] UCLA (1997). *The American College Teacher: National Norms for the 1995-96 HERI Faculty Survey*. Los Angeles, CA: Higher Education Research Institute of the University of California at Los Angeles.

particular learning skills. The need to promote dynamic and responsive TEIs considers widening the scope of diversity and of institutional autonomy, while ensuring effective accountability. Again, and always, it must encompass preserving the institutional integrity of TEIs, at the same time new forms of knowledge production (namely in the way presented since the early 90´s by Gibbons and colleagues[43]) 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 sub-functions, not always clearly defined, but which should be the subject of distinct public policies and forms of management, as follows:

- R&D, Research and Development, 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 of Conceição and Heitor (1999) and although the various sub-functions listed above are strongly connected among themselves, R&D and R&T are related with 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 of 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

[43] Gibbons, M, et al. (1994), *The New Production of Knowledg*e, SAGE Publ.

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 tertiary education institutions, not only by avoiding excessive dissipation of its resources in activities related to its links with society, but most importantly by maintaining the academic character of its 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 sub-functions, while ensuring the widespread availability of R&L. It is argued that a diversified higher education system can free the universities of 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 that does appear is how far universities can sustain their own independency and support integrity in research? Phrasing the Nobel Laureate Richard Ernst (2003)[44], "Universities should consider themselves as cultural centers

[44] Ernst, R. (2003), "The Responsibility of Scientists, a European View", Angew. Chem. Int. Ed. 2003, 42, pp. 4434 –4439.

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 foster basic university goals and preserve research integrity. In fact, many research universities have developed into new and innovative institutions, both national and international in scope, organised 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 addition, in recent years a number of Universities in Europe have created clusters and associations driven by student exchange programmes and growing research opportunities, as described in Table 1 for illustrative purposes. These clusters have been particularly focus on corporate matters and we argue that there is a need for a platform of 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 fostering integrity in higher education.

Higher education institutions 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).

A final remark should be noted about the legal status of TEIs, 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[45].

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

LERU (League of European Research Universities) http://www.leru.org/	**IDEA League** http://www.idealeague.org/	**CLUSTER** (Consortium Linking Universities of Science and Technology for Education and Research) http://www.cluster.org/
University of Cambridge	Imperial College London	Imperial College London
Universiteit van Amsterdam	TU Delft	Technische Universiteit Eindhoven
University of Geneva	ETH Zurich	Ecole Polyt. Féd. de Lausanne, EPFL
Albert-Ludwigs-Universität Freiburg	RWTH Aachen University	Technische Universität Darmstadt
University of Edinburgh	ParisTech	Institut National Polytech. de Grenoble
Ruprecht-Karls-Universität Heidelberg (Univ. of Heidelberg)		Universität Karlsruhe (T.H)
University of Helsinki		Helsinki University of Technology
Leiden University		Tech. Univ. of Catalonia, Barcelona
Katholieke Universiteit Leuven		Université catholique de Louvain J22
University College London		Instituto Superior Técnico, Lisbon
Lunds universitet		Kungliga Tek. Högskolan, Stockholm
Università degli Studi di Milano (University of Milan)		Politecnico di Torino
Ludwig-Maximilians-Universität München (LMU Munich)		Georgia Inst. of Technology, Atlanta
University of Oxford		Tsingua University Beijing
Université Pierre et Marie Curie, Paris 6		Ecole Polytechnique de Montréal
Université Paris-Sud 11		Tomsk Polytechnic University
Karolinska Institutet, Stockholm		
Université Louis Pasteur Strasbourg		
Universiteit Utrecht		
Universität Zürich		

In addition, recognizing scientific knowledge as a "public good" introduces the need to consider new policy dimensions in science and technology policy that are designed and implemented in a way that fosters independent scientific institutions,

[45] See, for detailed comparative analysis, Abrar Hasan (2007), "Independent legal status and universities as foundations", Paper prepared for the Portuguese Ministry of Science, technology and Higher Education.

among which the way in which transnational institutions are organized may provide a useful framework.

It is in this context, and taking again the case of Portugal, that the new Legal Regime of Higher Education Institutions approved by the Portuguese Parliament in September 2007 establishes 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 University management framework.

6. Summarizing: why we need institutions to gain societal trust?

If any conclusion can be taken at this final moment, 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 our 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 systems, 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 called for the need to promote an international market of excellence for university leaders, as also a critical path to attract our best researchers to take the lead of our universities[46].

I would also argue that **strengthening external societal links and "system**

[46] See, for example, Goodall, A.H. 2006. Should research universities be led by top researchers and are they? Journal of Documentation, 62 (3): 388-411.

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 organisations 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 in 2004[47], either in terms of renewing science education, or creating science culture, and here we reinforce this argument, as follows.

The need to better explain to the society at large the realizations of the academic and scientific communities and to foster the public understanding of science and of the role TEIs on scientific and technical development, where schools and other institutional settings (e.g., science museums) have a determinant role in stimulating curiosity and the interest for scientific knowledge. In this regard, the European report on the "Benchmarking the promotion of RTD culture and Public Understanding of Science"[48] clearly acknowledges the leading role of national programs such as the "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, tertiary education institutions 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)[49] still provides important guidelines to help moving towards a knowledge society in a fast moving landscape. The objective is to integrate systems of knowledge and ways of practicing, 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, tertiary education institutions are asked to strengthen their capacity to

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[47] European Commission (2004). Increasing human resources for science and technology in Europe. Eds., Gago, J., Ziman, J., Caro, P., Constantinou, C., Davies, G., Parchmannn, I., Rannikmäe, M. and Sjøberg, S.; High Level Group on Human Resources for Science and Technology, European Commission.

48 Miller, S., Caro, P., Koulaidis, V., Semir, V., Staveloz, W. and Vargas, R. (2002). Report from the Expert Group Benchmarking the promotion of RTD culture and Public Understanding of Science. http://www.jinnove.com/upload/documentaire/PP-fe-106.pdf

49 Solomon, J. and Gago, J. M. (1994). "Science in School and the Future of Scientific Culture in Europe", Euroscientia Conferences, Lisbon, December 14-15.

make the critical internal changes for modernising their systems of teaching and research within a path of diversity and specialisation, without compromising quality. Furthermore, by **enhancing their external links with society at large**, higher education institutions are asked to carefully improve their relationships with economic, social and political actors, thereby creating “new” reinforced institutions that have gained **societal trust**.