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Observatory for Fundamental University
Values and Rights

Managing University Autonomy

Shifting Paradigms in University Research

Proceedings of the Seminar
of the Magna Charta Observatory
15 September 2003

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Foreword

Prof. Roversi-Monaco
President of the Collegium, Bologna

The issue of research autonomy has been taken into consideration in several parts of the *Magna Charta*. Its preamble, for instance, underlines that the future of mankind will largely depend on the cultural, scientific and technical development fostered in those centres of culture, knowledge and research that are true universities. The preamble also points to the necessity of spreading knowledge among the younger generation by pointing to the great harmonies in life and nature that society must respect. Exploring the new and questioning the old – two of the basic functions of the university – require academic freedom, i.e., the liberty of mind, a great privilege granted to academia by society. Its importance and the necessary accountability going with it are at the core of the *Magna Charta Universitatum*, a document that also binds academic freedom to the universities' institutional autonomy.

Such a vision questions the strict connection made between teaching and research, today especially, at a time of exceptional growth in scientific and technological de-

velopment. Thus, how does the usefulness of knowledge influence the interest shown in its exploration by various external partners of the university? In other words, what value should be given, in terms of academic freedom, to project analysis and innovation transfer? What are the differences to observe when comparing research development with fundamental, curiosity driven research? What rights have governments and other stakeholders to intervene in the choice and development of research?

To deal with this complex issue, the Observatory, at the occasion of the 15th anniversary of the Magna Charta, decided to hold a conference on *University Autonomy and Research*. It is the second in a series dedicated to the management of university institutional autonomy.

The Observatory hopes that the partners of academia represented at this conference – from government, industry or from finance – as well as the comparative study commissioned to Ulrike Felt from the University of Vienna, have set the topic in a new light and helped deepen the reflection on the changing balances of the links between teaching and research, between social relevance and intellectual appropriateness. The university, indeed, is the ideal forum of tolerance where all these aspects meet, where teachers can impart not only accepted scientific thought but also new ideas put to the test of enquiry, and where students, able and willing, can enrich their minds with innovative knowledge. Hence the invitation for that meeting also sent to young researchers who said how, in their laboratories, they live up to the many conditions of an innovation environment. Innovation, indeed, comes from research and that is why it has a place of election in the system of education as well as in the transformation processes affecting firms and companies. Their cross-fertilisation is being discussed below by Ian Leslie, from the Computer Laboratory of Cambridge

University, that has partnered with large companies like Microsoft or Marconi.

Education and economic transformation are thus both key sectors for society; indeed, the links of freedom and responsibility are essential for defining the university's relevance to the community – whose problems academia is expected to solve, or has been expected to help solving over some ten centuries! And that is why, in many countries, society is ready to invest large sums into the success of the universities.

This is perhaps not so much the case in Italy but we trust that the trend will change in the direction of the pointers made by some private institutions already, banks, foundations or industrial groups. More specifically, as explained by Corrado Passera in his presentation, the personal financing of the students needs to be developed, either by supporting the efforts made by their families, or by organising their direct support through a system of loans that would turn their cursus into an investment in their future, a future of social mobility that would be the basis for the reimbursement of their debt. Loans would concur to the well being of universities which have also been promised an increase in their research funding – to approach the European criteria proposed by the Commission in Brussels, a matter that Lucio Stanca, the Italian Minister of Innovation and Technologies, has mentioned. More funds does mean more responsibility, also in terms of a better coordination of public and private research centres, a topic that has been addressed by Klaus Mueller, from Hoffmann-La Roche, in Basel.

Indeed, the topic is wide and I am sure that this conference has contributed – as shown by these proceedings –

to sharpen ideas and concepts, so that renewed strategies and policies can be envisaged – for academia and its many stakeholders – in order to manage best the constructive links that give university research its social specificity.

Message

Romano Prodi
President of the European Commission, Brussels

Distinguished speakers and guests, dear colleagues, ladies and gentlemen.

I am sorry not to be with you to give my greetings in person. You know how much I cherish my *alma mater* and how keen I am on the subject of your Conference. Since its very early days, the University of Bologna has been a leading light in the firmament of Europe's institutions of learning. So I congratulate the organisers on their initiative in arranging for this Conference to meet there.

Independence and impartiality are fundamental both to good research and to good teaching. Accountability has always been the corollary of autonomy. In today's world, the advent of globalisation and the emergence of the knowledge society are the latest factors to which our universities need to adapt.

Several trends can be put down to globalisation: there is transnational convergence of higher education and research systems with the development of joint curricula and research networks. The reduced role of the

State in market regulation means that knowledge is taking on an increasingly commercial value. More business-like management has been introduced into universities. Meanwhile, the internet has enormously increased people's access to knowledge and ways of exchanging and disseminating it.

Last February, the Commission published a Communication on *The role of universities in the Europe of knowledge* with a view to launching a debate on the topic. It addressed three basic issues – accessing sufficient resources, consolidating excellence and broadening perspectives – and I see from your programme that your discussions will touch on these concerns. In April next year, the Commission will be organising a conference in Liège to wind up the debate.

Reactions to the Commission's paper showed there is broad consensus that research cannot be divorced from teaching – hence the problem of reconciling the democratisation of higher education and the need for excellence in research. I would stress two points in this connection: first, closer relations with industry should not be developed at the expense of academic research, and secondly, it should be borne in mind that universities have a broader impact on the regional socio-economic fabric than technology transfer activities would imply.

Fostering the development of networks of research and teaching institutes and centres of excellence is a vital aspect of the EU strategy to developing the European Research Area. We need more mobility for researchers, teachers and students, so that the countries of Europe can open up to each other and Europe can open up to the world. One of the keys to achieving that is more autonomy for universities. By stepping up their ability to organise themselves they will improve the work they do.

Enhanced autonomy will increase our universities' accountability, and Europe may regain its place at the centre of world learning and innovation.

My very best wishes for your Conference.

Bologna, 15 September 2003

University Autonomy in Europe:
Shifting Paradigms in University Research?

Autonomous universities in knowledge societies: the impact on research

Austria, Germany, Finland, France, Greece, Hungary, Italy, The Netherlands, Spain, United Kingdom

Prof. Ulrike Felt
in collaboration with Michaela Glanz
University of Vienna

> *Science is certainty; research is uncertainty. Science is supposed to be cold, straight and detached; research is warm, involving and risky. Science puts an end to the vagaries of human disputes; research creates controversies.*
> *(Latour 1998: 208)*

Universities are centres of research and education and poles of regional development at the same time. Investing in universities is one of the best investments we can make for our future.
(Philippe Busquin, 2003)

Introductory Remarks
Autonomous universities in knowledge societies: The impact on research[1]

The knowledge production sector – with its impact on social and economical development – has moved recently to the centre of national and international policy debates on change in society. Thus, the many expectations concerning scientific knowledge in general, the characteristics of knowledge production and institutional creativity or the conditions researchers request to act as science innovators – all these issues are now on the agenda of national, regional and international policy-makers. Universities, for a while, were largely "reduced" to their "higher education function" and, as a consequence, lost a good part of their innovation focus as research institutions; now, they make a return as central actors in the production and dissemination of knowledge, as well as in the training of qualified "knowledge

[1] The following report is a continuation of an enquiry made in 2002 and published in a first Magna Charta report (Felt/Glanz 2003). We had chosen eight countries, which built the basis for identifying the key-issues of the debate, but also underlined the differences that appear in the solutions adopted by various governments. These countries were Finland, France, Greece, Hungary, Italy, The Netherlands, Spain, and the United Kingdom. For this report we have added Austria and Germany: Austria because it is undergoing a radical reform of its university system and Germany as it represents a country with a high research profile, but with universities struggling to maintain/obtain rank and status in the national research landscape. Both countries represent a particular type of "university philosophy", an interesting additional perspective to our analysis.

workers".[2] As a result, academic institutions are under considerable pressure from various interest groups not only to rethink their role and position themselves as partners in the further development of knowledge, but also to undergo concrete reforms in order to meet better the new requirements of society.

In an earlier report on the major shifts of university autonomy (Felt/Glanz 2003, see also Felt 1998), we spoke of a *new social contract* now being negotiated between academic institutions and society, a metaphor describing the recent changes in university-society relations that are linked to the rapid and fundamental transformation of the environment. Today's university environment in Europe is characterised by the diminished role of the State as the funding agent of intellectual development; this induces institutions to give priority to the quest for research funds; at the same time, however, expectation grow that the knowledge produced in universities should be more sensitive to its context and that the potential applications of research should be considered at a much earlier point in time; moreover, the quickly evolving labour market expects university graduates who can easily adapt to change. All this points to leaner, more flexible and more efficient institutions whose effectiveness would be enhanced by innovative managerial structures and by supportive quality assurance mechanisms. These are but a few of the pointers to the universities' emerging brave new world. A common factor prevails everywhere: today's change processes can rely on scarce resources only.

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[2] The position of the European Commission with regard to this topic can be studied in: *The role of the universities in the Europe of knowledge*, Brussels, 05.02.2003, COM (2003) 58 final (http://europa.eu.int/comm/education/doc/official/keydoc/2003/univ_en.pdf)

The two quotations introducing this paper indicate the main tensions dominating the area. The first draws attention to the difference between science as a system of knowledge – which appears clean, stable, structured and well organised, on the one hand – and research seen as a rather messy and day-to-day activity, on the other, a process experiencing an instability in people and equipment that unbinds unexpected potential or, on the contrary, that imposes unwanted limits to innovation. This dual reality can be mirrored in the analyses made of research in universities, for instance when some assess innovation formally while others understand it as a trial and error process whose dynamics develop over time. The second quotation underlines the risk of contradictions at policy level when decision-makers underline the high expectations made of the role of the university but refuse to make the necessary means available, considering the fragile reality of state finance and investment.

Indeed, a superficial glance at the situation of contemporary universities in knowledge societies immediately shows that academic institutions must cope today with a number of conflicting pressures, while trying to reposition themselves – in particular vis-à-vis new players in the field. Institutions are thus often torn between paradoxical and contradictory developments. Let us just mention four of them as an illustration.

- While universities complain about declining social prestige, their actual importance is still on the rise – in their role as knowledge producers and as trainers of tomorrow's majority of "knowledge workers". In the literature, this phenomenon is called the knowledge paradox: in other words, at a time of pervasive knowledge, higher education institutions are not nec-

essarily considered as trustworthy and worth enlarged support. (Bleiklie & Byrkjeflot 2002, 519)

- The university system is expanding: this leads to a rise in expenditures – in absolute terms –, a rise that is often met by growing scepticism about the output of the institutions and about their capacity to meet the needs of society at large.
- If universities can claim major importance in tomorrow's knowledge societies/economies, they are losing at the same time a good part of their monopoly (especially in their teaching function).
- Universities are more and more expected to be co-workers in social development, i.e., institutions responsive to external social demands; however, their inner structures, in particular in terms of assessment, remain focused on the individual and on the internal dynamics of academic disciplines and activities.

In virtually all European countries, major university reforms have been the governments' answer to the obvious need for the universities' repositioning in society. These reforms have all in common an alleged shift towards more autonomy for the institution.

In our first study (Felt/Glanz 2003), we have investigated these shifts and the impact they had on decision-making structures within universities as well as on human resource management. In this paper, we will explore the impact of university reforms and the consequences of newly gained institutional autonomy on the research carried out in academic institutions. What do these changes in law and management mean for what is understood to be a core feature of the university system – the freedom of research? When university resources decline, how does this affect academic research agendas? If academic researchers are to be more conscious of the innovative po-

tential of their investigation, does this interfere with the self-understanding both of the institution and of individual researchers? These are but a few obvious questions. Most interesting is also the issue of research freedom within the university which, as an autonomous institution, tends to develop a collective profile on the basis of the personal creativity of its researchers – the latter feeling perhaps uneasy about an individual freedom now at risk of being jeopardised by their own university!

Before entering the debate in more details, we should note that the impact on research of changes in university autonomy has not been much studied while there exists a large corpus of literature that analyses, discusses and evaluates the impact of the new boundary conditions for universities on human resource management, teaching issues and governance structures – especially when legal reforms have led to increased autonomy. Indeed, little attention has been given to the impact of recent legal changes in university structures – allegedly reorganised for more autonomy – on the production of scientific knowledge, a field otherwise much debated. The same could be said about research concerning the relations between university, industry and the state: analyses either stay at high level of generality or, on the contrary, zoom on specific case studies. Thus, the question of changing legal frameworks and of their impact on the autonomy of research needs further exploration, especially insofar as it touches the issue of university autonomy.

In that sense the following paper is an explorative study, as it tries to investigate the impact of expanded university autonomy on the research undertaken in the academic institutions of ten European countries: Austria, Finland, France, Germany, Greece, Hungary, Italy, The Netherlands, Spain, and the United Kingdom. We try to offer a problem-oriented description of the major issues

that are at stake in higher education institutions considered as integral parts of the national research system; we look at the way the working conditions have changed in academic institutions on their way to increased autonomy. Our contribution is exploratory in so far as it tries to identify key-issues on the basis both of policy documents dealing with various aspects of research in universities, and of published literature analysing the research system, universities included (such as papers from science studies, higher education research, science policy studies, etc.). This material has been completed by interviews made of policy-makers and researchers[3] from the coun-

[3] We would like to thank the numerous experts who, in the analysed countries, were ready to expand on these topics. Among interviewees were university rectors and representatives of rectors conference, policy makers, researchers in higher education, as well as many people having valuable and broad experience of the university world. The interviews were semi-structured and covered five broad ranges of questions: legal changes with regard to university autonomy and their impact on research, financing structures and priority setting, knowledge transfer and intellectual property rights, quality assessment and, finally, the changing role of research co-operations. As some interviewees asked for anonymity, may we here express our gratitude to all, especially for the time they devoted to us in this rather general way. Over the past few years, we have also had many occasions to discuss our work with colleagues and to seek their vision, experiences and interpretation of what is happening in their respective university system.
They in no way take responsibilities for any of the conclusions here expressed about the situation in their respective countries.
I am also grateful to my doctoral student Luis Aparicio, who was extremely helpful in bringing together material concerning the changes in the Spanish university system.

tries mentioned above, all EU members apart from one accession country, Hungary.

The report is made of two main parts summed up by concluding remarks. The first section, entitled *"Shifting paradigms in university research? Repositioning university research",* sets up the general framework of the common questions used to assess ten different national situations – a survey that makes the second part of the document.

As an introduction, however, we will briefly sketch different myths about university research that now prevail in discussions, be it within the universities or in the public at large. It seems important to outline such perspectives as they offer strong rhetoric arguments for the debate on change while clearly reflecting solid but implicit value systems. We will then look at the two main strands of changes in research: the first one covers the "*new production of knowledge*" and does not only address the important shifts taking place in the production of scientific knowledge but also reflects the consequences such changes may have for the universities' role and position in society; the second one, focusing on the changing university-industry-state relationships, is referred to as the *"triple Helix-debate"*. These two approaches, although far from being the only ones made at conceptualising change in the research sector, do fit rather nicely with many of the issues evoked in our empirical analysis.

Universities, however, are not simply objects for policy making; as partners in change, they are also social subjects with a high capacity to reflect on their own situation, to analyse their changing conditions and to develop strategies shaping their environment in such a way that they can fulfil their tasks. Thus, when analysing the evolution of research conditions within universities, we consider the university research system as something wider and deeper than its explicit and external regulatory

framework. Indeed, change answers a variety of different forces at work both inside and outside the university. The negotiations in which these forces engage differ in their degree of emotionality and – as we will argue – they involve very different forms of power relationships, often based on a large spectrum of interdependencies. Which forces are at work within universities in shifting and shaping the boundaries of the research system will be dealt with in the third part of our introductory section.

As for the second part of this report, it focuses on the more concrete observations made in our field analysis of research autonomy in the "reformed universities" of the ten countries under scrutiny. After some introductory remarks, our reflections will be organised around three central perspectives. The first one reflects priority setting and profile building – including issues of research financing, as this represents a central item for the reorganisation of the university landscape. The second one is devoted to the conditions of knowledge production and transfer, to networking strategies and issues related to intellectual property rights. The third and last area of interest concerns issues of quality control and strategies of accountability: they are important indicators of how the different local, national and global value systems interact with each other and of how they take shape.

I. Shifting paradigms in university research? Repositioning university research in the European context[4]

I.1. The European university – myths and changing realities

To question the repositioning of research in European universities calls for some reflections on the ideas and value systems that underlie academic institutions and explain their historical development. Of particular interest is the set of narrative elements, constantly referred to in the debates about university reform, which are used as a platform of common identity. We call them basic myths. And, as all myths, they contain grains of historical truth rearranged for maximum explanatory power. Most university members, as single persons, would agree that clear evidence lacks to support the supposed "realities" of the system. The function of such myths, however, is to offer shared understanding of universities as institutions through a culture and history that justify the greater cohesion of a rather fragmented and heterogeneous institution. Myths are thus the glue which holds together an incredibly diverse type of organisations. They make it possible to find common grounds for communication and debate: thus, they allow for the development of validated knowledge.

For our purpose three of these myths seem central:

The first refers to the university as an *institutional space free of politics and power relations*. An independent social space protected from political pressure and direct social control is perceived as an indispensable prerequisite for the efficient development of high quality objective knowledge. Within this space, choice criteria rely on ra-

[4] For an overview on the broad body of literature dealing with trends and perspectives in academia in the 21st century see: de Boer et al. (2002).

tional arguments: those who hold the better argument are supposed to win.[5] Indeed it is rather easy to deconstruct this myth, simply by investigating the decision-making processes, the career structures and the concepts of management. Then, it becomes obvious how deep politics and power relations have permeated university structures – down to the lowest level of decision-making. Power games would certainly need to be reflected upon more thoroughly when reshaping and re-structuring the world of academia.

The second myth considers that *universities once lived in a "golden age" of basic research*, when science was free of those crass economic problems that now pollute much of the public debate around universities. In fact, when looking at the differentiation process that developed in the research landscape of the 19th century, it is clear that the universities have used their self-definition as "places of pure research" (not directly linked to any application) to claim independence from the state while obtaining financial support from it. Away from financial interest, applicability and other practical considerations, universities could thus claim the right to set their own internal standards, to take decisions about where research should go and to assess the value of its results; in short, academic freedom in the quest for new knowledge could be assured.

Indeed this idea of a golden age is rather powerful still, although the concept has obvious limitations. The first consists in the fact that a clear separation between basic and applied research has never been made. Indeed, interactions between university labs and industry have been part of scientific development throughout the past.

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[5] Examples analysing the complexity of boundary drawing in science as well as of power structures in universities/in science are for example: Gieryn (1995), Paris (2001), Braun (2001).

Secondly, history shows that innovation often goes from technology to science, rather than the contrary; as a matter of fact, much of modern science has produced scientific innovations in close interaction with technological progress. Thus, technological development cannot be seen as the result of basic research only; rather the development of the two systems should be understood in terms of "co-evolution". Thirdly, much of the growth of the science system – also in areas more oriented towards basic research – has been made possible by funds coming from the private sector while much of the research itself is taking place in industrial laboratories or in innovation networks including them.[6]

The third central myth concerns the *unity of research and teaching* as embodied in its pure and ideal form, *the person of the university professor*. Although this ideal was incorporated in the Humboldt model of the university, it has never been realised in the way it was referred to on paper. Indeed, the myth emerged at the turn of the 19th to the 20th century and became a central element of the narrative on universities and an integral part of their self-identity. (Ash 1999; Schimank/Winnes 2001).

However, the unity of research and teaching in one person as the only true model for organising the university is increasingly being questioned. The massification of higher education, the development of new information and communication techniques that made possible new didactics (like *e-learning*[7]), but also the diversification of university activities are actually contributing to a gradual

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[6] See Nowotny/Felt (1997).

[7] Some key documents and recommendations at the level of the EU can be found at:
http://europa.eu.int/comm/education/doc/official/keydoc/keydoc_en.html

shift of the unity of research and teaching from the individual to the level of the institution. Thus, research and teaching would now be taking place under the same institutional roof, but would not necessarily be done by the same people.

To be aware of these "core narratives" is important to understand the issues around university reforms as such myths influence the acceptance of change by offering internal references that give meaning to the institution and its members.

I.2. Knowledge production and the role of universities

When looking at the way scientific research is organised in contemporary universities one cannot but be struck by both its fragmentation and continuity. Fragmentation occurs as researchers are forced to organise the resources they need for their work (in terms of finances, equipment and project collaborators) by engaging in different kinds of projects, with different financiers, with different – and sometimes contradictory – expectations; continuity is created by the requirement to follow a given research direction over a longer period of time so that expertise is being accumulated in a specific domain of science; this means bridging, circumventing or counterbalancing the limitations of fragmentation. To do so, funding mechanisms and priority setting have become important tools of intervention in otherwise rather autonomous institutions, thus indirectly steering the scientific research taking place there. On the "receiving" side, researchers and research groups try to navigate investigation possibilities and get over the limitations created by funding and priority structures, thus developing their own vision of the research to be done. Their aim: influencing and getting the control of the environment

they are embedded in by developing strategies using the few flexibilities existing in the finance and human resource management.

This type of research organisation arose during the 20th century and only became dominant after World War II. In the 19th century, when (what we now call) policy-makers wanted to steer the research carried out within a university, they tried to act through personnel policies mainly; they would select a professor with a given research profile, a person who could pursue investigation in his field over a long period of time; so, the control of professional input was one of the only means available for renewal and innovation. Research policy would thus be subsumed under university and personnel policies. A differentiation between research and university policy (and a change in the way university policies were implemented) gradually occurred in the early years of the 20th century. As a result, the focus of policy-making shifted away from outstanding persons with exceptional intellectual profile to research programmes – and the values they did represent. (Stichweh 1994)

This had far reaching consequences for research as well as for its steering: new knowledge would no longer be seen as emerging at unforeseen times in a more or less continuous quest for the new; rather, scientific work started to be organised around what we now call *scientific projects*. "Elementarisation (*Elementarisierung*)" of research is the term Rudolph Stichweh (1994) uses to describe this phenomenon. This modularisation had far reaching consequences on the rhythm and kind of knowledge that could be produced. By considering science as an activity distributed in many different projects – with different aims and actors or with different time horizons –, it became possible to link the money invested with the research question under study, to limit the time scale of in-

vestigations and to evaluate the outcome from a specific project. However, questions that would not fit piecemeal approaches would no longer be asked. Indeed, as they could not enter projects, they had become inappropriate under the new conditions of research development.

The project orientation of research, however, has now become a central characteristic of a system boxed in the boundaries and logic of academic disciplines: disciplines had developed over the 19th century as the centres of interest allowing to grasp the known on the way to uncover the unknown, i.e., as the structures of science as an intellectual activity. With their study *"The new production of knowledge: The dynamics of science and research in contemporary societies*" Michael Gibbons and his co-authors (1994) have triggered a debate on the shift of the mode of knowledge production away from these classical structures. They underline that besides the classical, disciplinary organisation of knowledge production – labelled *mode 1* – a new form of research has emerged, which they call *mode 2*. To quote the authors,

> "the new mode operates within a context of application in that problems are not set within a disciplinary framework. It is transdisciplinary rather than mono- or multidisciplinary. It is carried out in non-hierarchical, heterogeneously organised forms which are essentially transient. It is not being institutionalised primarily within university structures. *Mode 2* involves the close interaction of many actors throughout the process of knowledge production and this means that knowledge production is becoming more socially accountable. One consequence of these changes is that *Mode 2* makes use of a wide range of criteria in judging quality control. Overall, the

> process of knowledge production is becoming more reflexive and affects at the deepest levels what shall count as "good science". (Gibbons et al. 1994: vii)

This quotation sums up the argument which the authors develop in detail throughout their book: much of the knowledge that needs to be produced in contemporary societies has to be different from the classical ideal. As a consequence, universities – with disciplinary structures – run the risk of losing their central position as knowledge producing institutions: they might even have to hand over much of their power to other institutions which are better adapted to this kind of research organisation and knowledge production. However, besides some marginal remarks, this 1994 analysis of knowledge production does not really discuss in detail the universities and their specificities. One could argue that this corresponds to the "mood of the time" as, in the early 1990s, universities were not regarded as central research institutions in the European context. Indeed, they were not seen as key players in the field of research at all; at best, they were considered as problematic structures rather ill-adapted to respond to the demands of society.

Pursuing their exploration of *Mode 2,* the authors published a follow-up book in 2001 (Nowotny et al. 2001) with the title *"Re-thinking Science: Knowledge and the Public in an Age of Uncertainty*". It is fundamentally different as regards universities. Not only does it include a full chapter on the role of universities in knowledge production, but it puts also the universities on the central stage of both research and education throughout its various chapters. The authors, however, stress that if universities for a long period could set the elements of their self-defined identity to persuade the people in power of their functional validity as key-players in the field of new

knowledge production, this has now changed dramatically. A new and rather different interpretation of the institution is emerging at present. By its commitment to more

> "democratic and more vocational forms of higher education and its involvement in more contextualised forms of research, the university has taken on new and more diverse roles that may well be incommensurable and even incompatible with each other. The feeling of a deep crisis of purpose, of administrative managerial structure and of budgeting is pervasive in many universities today. The boundaries between the university and other types of post-secondary education and other parts of the research system have been steadily eroded." (Nowotny et al. 2001: 80)

In that sense, the universities are and will be forced increasingly to reposition themselves by integrating a broad variety of tasks, thus becoming more responsive to the fullness of change. We would argue that what is being observed corresponds in fact to a *de-differentiation* in the range of research institutions: the idea of clear borderlines between different types of research institutions working on tasks of their own in an orderly way has to be abandoned. The university today is called to commit to new forms of partnerships often grounded in a very local environment. How that affects the overall image and self-understanding of the institution remains yet to be investigated and will be addressed in some detail in the empirical section that follows.

Evoking new partnerships leads us to a second strand of very lively debates on the changing role of universities, namely the one on the shift affecting the relationships between *university, industry and government*. This

discussion crystallised around a metaphor introduced by Etzkowitz and Leydesdorff, when they tried to offer a framework for describing and analysing the links developing between these three key players of knowledge production. They speak of the *"Triple-Helix"*.[8] In their work, they take a clear counter-position both to the idea that the state is the overriding actor that dominates industry and academia, as well as to the idea that all three entities are independent players trying to influence each other. For the authors, each of the three institutional categories represents one helix which is going through different stages of development. Then, increasingly complex patterns of interaction emerge between the three helices while, at the same time, the environmental conditions go on changing, thus eliciting new strategies for change, the set up of sub-institutions or the creation of integrative mechanisms that can meet emerging challenges.

This process of transformation is perceived as being endless and dynamic, with no clear definite goal or ideal end, the driving force for change coming from the new economy and its emphasis on knowledge. Institutional boundaries are now being blurred, while functions become interchangeable. The triple helix model considers that the dynamics of society have changed from one of strong boundaries between separate institutional spheres and organisations to a more flexible and overlapping system, in which each part can take over the roles of other partners. Universities, industry and governments are thus three independent institutional spaces thought of as relatively equal. However, they overlap and develop more or less stable functions that enter the respective space of the

[8] See for example: Etzkowitz/Leydesdorff (2000), Etzkowitz (2002), Leydesdorff (2000), Leydesdorff/Etzkowitz (2001), Ernø-Kjølhede et al. (2000).

others. To give but one example of such role shifts: the university has become an entrepreneurial institution[9], thereby reshaping the norms, practices, goals and organisation of academic science. As a result, research findings are increasingly transformed into intellectual property that can be turned into marketable commodities, thus contributing to economic development in a rather visible way. Industry, on the other hand, contributes more and more to the education of "knowledge workers", thus taking a role long considered to be a university monopoly.

These changes, of course, are happening at different speeds in different parts of the world and their development seems to depend heavily on the different local and regional settings – with their past histories. Moreover, in certain settings, transformation is born out of bottom-up initiatives taken by individual researchers while, in others, more global policies try to enforce a more integrated approach to knowledge production in a top-down mode.

If we follow such ideas, what are their consequences for the development of science? What does remain of the specific role of universities in knowledge societies? Can we already detect the creation of "sub-institutions" trying to answer the demands expressed in the close interactions developing between industry, the universities and government? Once the value system founding university research has spread away from academic institutions, can the sustainability of the knowledge base last over long pe-

[9] We use the notion of entrepreneurial university in a slightly more extended understanding than Burton Clark introduces it in his 1998 book. Entrepreneurial as a description of a university addresses here a broad range of elements which reorient the internal university management and its relation to the outside along criteria which are similar to those used by other more economically oriented institutions.

riods of time? Or should the university focus rather on its educational tasks in order to retain a specific role in the chain of institutions producing knowledge? These are but a few questions which flow from renewed concepts of research; they will reappear once we enter our empirical study.

I.3. On the relation between the autonomy of universities and the autonomy of their research: changing environments and negotiated boundaries

The previous two sections led to the conclusion that the universities' space for autonomy largely depends on the complex forces shaping their environment. The actors are many, their understanding of knowledge production diverse, their interventions fragmented in time and space; all, however, try to influence the system, more or less explicitly, a system whose legal framework, institutional rituals and tacit regulations set the boundary conditions. Thus, when speaking of research autonomy, we always mean the outcome of a complex process of negotiations. Consequently, to understand how research develops in universities, we first need to identify the different forces at work.

Figure 1 attempts to define the most important elements of the system by regrouping them in seven major clusters, which we will all consider in some detail. We should be aware that some of these act simultaneously and sometimes in contrary directions – this is true at least on three levels, the institutional, the national and the international. In countries with strong regional autonomy (as in Spain or Germany for example) a fourth level can be considered, the region.

At first, it is important to look at the legal frameworks which may have an effect on the autonomy of re-

search. This does not mean considering simply the concrete measures that define this activity but rather understanding how legal constraints affecting other aspects of university life can influence the degree of flexibility that university research can hope for. Thus, for example, the legal status of staff (junior researchers in particular) is important; but so are the contract policies, the evaluation and career procedures, the distribution of different tasks among research and teaching units, the management of resources – and much more. Moreover, it would be appropriate not only to look at formal regulations but also to understand the underlying cultural values that account for the way regulations are being dealt with; thus, one can analyse how a formal framework translates into informal day-to-day routines.

The second key shaper of research freedom is funding. What is the place of research in the university system of internal resource allocation? What are the different funding bodies existing in the national context and how easy is it to get access to international financial sources? Is funding programme-oriented or does it allow for transversal needs, thus stimulating a broad and diversified development of knowledge production activities? What role does applied research play in relation to topics more oriented towards basic research? Is research co-operation requested with institutions other than universities? How much space do funding programmes give to different fields of research and how do the humanities and social sciences get funds under the new economic logic? Finally, one should take account of the strong impact that certain funding mechanisms can have on the inner workings of a laboratory or on collaboration across institutions, for instance when industrial partnerships require strict confidentiality rules.

A third aspect of our enquiry evokes the structures that facilitate co-operation within and between different institutional settings. This question becomes essential when, for example, we accept the arguments developed by Gibbons, Nowotny and others according to which scientific knowledge is no longer expected to refer to one discipline only, but that it should transcend disciplinary boundaries, thus requiring new forms of collaboration in order to achieve the new types of know how required by society. The capacity to enter such novel kinds of research collaborations (in other words, to become attractive partners for various outsiders) is certainly a central challenge for academic institutions: can a classical university dare be creative, at the risk of external values intruding the core of its academic knowledge production – thus affecting its long term potential for innovation?

A fourth area of interest is what we call "bureaucracy", a term covering the organisational and decisional structures which the researchers and research units are bound to live in. What are the hurdles faced by free and sometimes risky research directions (in terms of investments) as new ideas are being developed from within the organisation? What is the ideal balance between allowing the individual researchers or research groups to decide on the investigations they want to pursue, on one side, and an internal policy that decides on the main research priorities and the pooling of resources, on the other?

Quality assessment and assurance mechanisms also shape the potential and the limits of research in universities. They express the basic values and criteria research should meet. Peer review represented the traditional system of evaluation as long as research centred on individuals whose work was publicised in high quality journals; with the transformed organisation of research – based on teams – the definition of success criteria is no

longer left to the core scientific community only. Indeed, outsiders can now express their expectations and values in systematic assessment exercises. Furthermore, quality assessment procedures often take place at different levels and simultaneously, not necessarily on the basis of the same criteria. This can cause confusion and make it difficult to develop a more coherent research agenda. With the increased autonomy of universities, quality assessment has become a central issue, all the more so as evaluation is not often regulated and controlled by the universities themselves but rather by central policy-makers or by institutions specially created to coordinate and carry out such assessments. How these tools are being used to interfere in the research system is thus an important element to consider.

What happens to knowledge once produced is the next step in our analysis. Is it sufficient to publish in quality journals or should not the universities try to transfer quickly the acquired knowledge to potential users – thus ensuring intellectual property rights in as many cases as possible? While it seems sensible to facilitate the transfer of knowledge, one also has to see how these policies feed back into the research system and change its ethos. In the domain of biotechnology, for instance, the role of patenting for basic research is heavily debated as it could jeopardise, in part at least, the free communication within and between laboratories.

Behind most of the considerations above hides our final perspective, namely the interests developed and expressed by society vis-à-vis science, i.e., the social expectations which the university should meet as an institution carrying out research. What are the main requests addressed to universities? What are the criteria of success for academic work? Which are the other tasks – besides research and teaching – that universities are called to ful-

fil? Who – on society's behalf – can speak in public debates and impose a certain vision of the university? These considerations have an important impact – although often very indirect – on what value is given to the university as a central player in the development of knowledge societies.

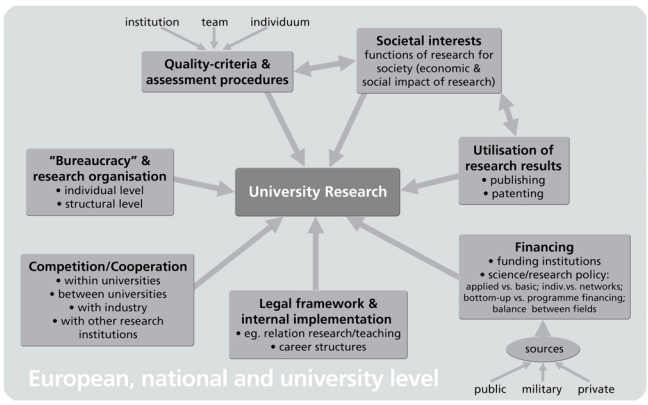

Figure 1: Forces shaping the degrees of autonomy of research within universities

II. The multiple transformations of the research environment within autonomous universities

Austria, Germany, Finland, France, Greece, Hungary, Italy, The Netherlands, Spain, United Kingdom

The second part of this paper tries to draw together and structure a broad range of observations concerning the changing boundary conditions for research within universities – now that these institutions are supposed to have acquired greater autonomy from the State. The shift in the perception of how research is or should be embedded in autonomous universities is at the heart of our in-

vestigation: what parts of research activities are in need of regulation? What active role should universities play in shaping the research system as a whole? What other roles should they or should they not play? On the basis of the material and people consulted, the answers to these questions are still exploratory, i.e., an attempt at identifying the key issues that should be considered further when developing university policies.

Before entering details, we should keep in mind that in drawing together such a variety of observations, there is a crucial difference between what is expressed formally at policy level (the legal changes mainly) and the way these new regulations are being transformed into institutional and individual routines. Thus, we do not only need to consider the formal results of the move towards more autonomy for universities, but also to envisage the informal consequences that certain changes might bring.

Secondly, it seems essential to differentiate between the autonomy of the university system from the state, the autonomy of individual universities in particular and the autonomy of researchers and research groups. Autonomy – as argued in our earlier report and as shown in some detail for the research side in *figure 1* – is articulated in many different ways, in different places and at different points in time; as a consequence, autonomy is to be understood as a continuous negotiation redefining academic positioning, a procedure rather than a status for universities to enjoy.

Thirdly, when looking at different national university systems, we have to remember that the variations within the national systems are sometimes larger than the differences appearing between them. This statement holds true in particular for the role attributed to research in different forms of higher education institutions. As a result, changes – as we will analyse them – do not concern all

levels and parts of the system in a homogeneous way, even if such differences may be crucial for judging overall developments.

Fourthly, traditions play a central role in universities that often can refer to a long past. In that sense, recent reforms will often not show their impact before several years and change could be lessened by well-tried procedures of negotiated adaptation. In many of the interviews, a high degree of trust was expressed: universities having survived so many changes of regime will certainly find the capacity to protect intrinsic interests through strategies counteracting unfortunate change in their environment – thus, their development will not be really hindered.

Finally, we should recall the strength of common myths in the shaping of university identities. We mentioned three of them, the university as an *institutional space free of politics and power-relations*, the university nostalgic of *a "golden age" of basic research where economic interests could be kept outside the institution* and the university as *a centre uniting research and teaching*. These narratives are persistent in both the policy documents and research papers, as well as among interviewees. They represent a backdrop to any evaluation of the actual situation and changes that can be observed in university autonomy.

To understand the impact on research of recent changes in university autonomy, we first need to monitor if and how the regulations constraining academic research have changed. In other words: in the ten countries under scrutiny, have the most recent university laws modified the organisation of research? And if so, does this directly affect the production of knowledge?

In a fascinating way, most of the people we interviewed – or talked to informally – first reacted by denying any direct impact on research activities of recent changes in university laws tending to expand the autonomy of

academic institutions. Implicitly, however, they considered research as an activity typical of the university, that is an element of its institutional profile and identity – even if such work is not directly financed by the institution. From that point of view, we could call research an "integrated add-on activity". This explains why was often expressed the opinion that new laws have no need to regulate research as a specific task of universities. Anyway, research is supposed to be regulated already by evaluative procedures from the international scientific community or from research councils and other funding bodies. Accordingly, research is perceived as being autonomous *per se*: enjoying some kind of guaranteed freedom, it is not really being influenced by the changes in university structures and management. Such an understanding can also be explained by the experience of university budgets that are organised around the needs of the teaching sector mainly – the requirements of research, beyond the most basic infrastructure, receiving low priority.

Concerning this issue, an interesting difference between the UK and the university systems on the continent became apparent. While, in the UK, research money is explicitly allocated to universities on the basis of indicators in the research area, continental university systems generally rely on inclusive budgets covering all institutional activities, so that research quality, although important, plays little role in the overall distribution of State money between institutions. Most research money, anyway, is supposed to be attributed on a competitive basis by funding bodies external to the university: henceforth, changes in university law are not perceived to be crucial for this sector.

Furthermore, the international character of science is often underlined by the interviewees to argue that research does in any case transcend the boundaries of any

single research and teaching institution. This points to an interesting contradiction in the answers as they refer to two types of rhetoric. On the one hand, international science, with international standards and universalistic claims, is emphasised, thus implying that national frameworks play a minor role only. On the other hand, in many national policy documents, the importance of research for national or regional development has been underlined by stressing that innovation should become more context-sensitive and more aware of the local and regional needs.

A second look at the recent evolution of the university sector, however, reveals a number of changes, which shape indirectly the ways in which scientific knowledge production can take place, thus setting boundaries for the level of autonomy which research can attain within universities. Without claiming to be exhaustive, we would like to address now three important perspectives that were usually identified as having an impact on university research. We will not deal explicitly with questions of human resources, although they touch the creativity potential of the research sector. The reason is that we have touched on these issues in our 2003 report (Felt/Glanz 2003). Moreover, the articulation of research and teaching should be at the core of a follow up study that will focus on human resource development in universities.

For the moment, we will concentrate our analysis on *profile building* and *priority setting*, fields of interest that are often strongly formulated in recent reforms. Profile building needs also to be linked to the financing of research, all the more so as it influences the positioning of universities vis-à-vis other knowledge producing institutions in the country; this has consequences on the setting up of collaborative networks too. As for priority setting, we will look into the changes concerning knowledge pro-

duction and transfer as well as intellectual property rights. Our third field of interest will cover accountability procedures and quality assessment mechanisms – a growing area of concern and activities in the university world.

II.1. Repositioning universities: priority setting and profile building

An increased degree of autonomy towards the state has a number of far reaching consequences for the universities – both considered as individual institutions and as parts of a system of higher education and research. Being autonomous implies the capacity to engage freely in outside linkages; to do so, the institution needs internal structures that allow responsible and free commitments, i.e., the capacity to formulate a position, to build the actors' confidence in a chosen profile and to act along those lines. This has proved difficult steps to take, as academia usually resembles "a herd of cats" rather than a board of trustees! Even if we speak of a "scientific community" and refer to "common norms of behaviour", we know that, in universities, these terms at best define some kind of cohabitation. The individual scientist, indeed, with his or her intellectual specificities, with a strong sense of devotion to intellectual work (and other characteristics can be added) still plays a fundamental role in the academic system. All procedures for the granting of exceptional rewards, for instance, still focus on individual researchers rather than on the small teams that develop winning projects; career evaluation is thus based on the contributions to science made by the individual being assessed rather than by his or her group. In that sense, a growing autonomy at university level would demand a new understanding of the relation between the institution and the individual researchers or research teams it employs.

In parallel to the development of institutional autonomy, universities also experience a strong trend towards internationalisation. More and more, researchers and students move between institutions and countries, and issues of brain drain and brain gain are now central themes for academic policy-making. In such a context that requires the development of sectors of academic excellence, profile building has grown into a strategy for attracting the best scientists from other countries or, at least, for retaining the best minds in the country – rather than letting them move to the US, the country of highest attractiveness in science. In other words, in an increasingly globalised sector of higher education, gaining visibility means highlighting institutional specificities.[10]

A third reason for profile-building lies in the competition with other knowledge producing institutions in the national environment. There are growing divergences between public and private universities, between classical universities and institutions offering vocational training, between technical universities and institutions mainly dedicated to basic science, between specialised institutions and universities offering a full range of disciplines, between institutions with limited or with open access, between universities requiring fees and those offering free education – and all these features can be variously combined. Thus, there is a need for boundary work to define each institution's specificity, i.e., to determine what makes it different from others. Not surprisingly, institutions do not agree on their various roles – ascribed in function of their claimed strengths and supposed weaknesses. This leads to fierce competition, in particular for the best stu-

[10] For a snap-shot on the issue see EU policy document: *Weakening growth in investment and increasing brain drain: two major threats to the European knowledge-based economy*, IP/03/1594, 25.11.2003.

dents in those countries where tuition fees represent a major income for universities – like in the UK.

When trying to understand the process shaping such profiles – that is the setting up of a responsible academic identity –, not only the actual features of a university have to be taken into account but also the vision the institution would like to embody. Let us just mention two examples. Although, seen from the outside, one would quickly agree that some universities are very weak in terms of research and are in fact teaching institutions mainly, the ideal of the research university is so strong still that it influences also the desired profile of such institutions, the Humboldt model being the only correct and acceptable one. In the German debate, this is particularly visible but analysts of the British situation point to similar situations in the UK. In fact the focus on research indicates an implicit hierarchy in the argumentation developed by many academics. While teaching and high student numbers are used to argue for more funding, research continues to be rated higher than education in the implicit value system of the European scientific community – and in Britain this is particularly reflected in the research assessment exercises. A similar point could be made about the unity of research and teaching. In the countries of Humboldtian tradition, strong emphasis is put on the fact that university teachers are also active researchers – or vice versa. If, ideally, the argument is valid still, in reality the growing number of students – linked to mass education – no longer allows for close collaboration between students and teachers around innovation development.

Investigating the autonomy of universities leads to observations on the budgetary issue. This can be tackled from three angles. The first discusses the allocation of basic budgets to the universities. In many countries, expanding autonomy meant the definition of global budgets

that can be guaranteed for a few years. Management by contract implies, however, that universities are able to define their goals clearly and to translate general objectives into implementation policies. In many ways, this demands a fundamental change in academic mentality as university staff and leaders are now asked to commit to planning and realising potential futures – together. Yet, this is only possible if precise accountability structures have been set up while, at the same time, enough margin for manoeuvre should be left to allow for quick reaction to unexpected development. Indeed, the more rigid are accountability and quality assessment structures, the less people will be able to change direction and create radical innovation in their domain (see also chapter II.3).

The second issue is that of "academic capitalism". That notion was introduced by Slaughter and Leslie (1997) but, in our context, we would slightly expand its meaning. While these authors mainly see academic capitalism as the scientists' answer to growing market activities, we would like to subsume under this notion all actions directed to the acquisition of additional funds from sources other than the basic budget of the university – a search for funds that has become quasi an obligation for academic researchers in particular. In a case study about Finland, Ylijoki (2003) demonstrates how far the intrusion of business notions such as priority setting, profile building and managerial steering has affected university administrative practices. While the author also argues that such influence has not led to uniform change – each university developing its own answers to new situations –, he nevertheless stresses the existence of some common basic features in this opening to market behaviour: in particular, senior researchers become employers and indirectly the managers responsible for an increasing number of young researchers, whom they employ through *ad hoc*

projects. There is no long-term perspective for such a responsibility as research is understood to be a chain of smaller projects; this introduces uncertainty with regard to the continuity of investigations; the researchers employed under these conditions depend on short-term contracts (see below); they have no real career prospects and the feeling of uncertainty is reinforced by time pressure and increasing work-loads; as a consequence, management pre-requisites prevail over all other considerations. In other terms, the necessity to perform along the lines of academic capitalism does not enlarge the autonomy of research staff, rather it reduces it.

The autonomy of research also depends on a variety of funding sources, be they national or European, whose diversity is reinforced by the many mechanisms used to make funds available. The term funding structures is used here to describe whether research funds are available through focused programmes for which scientists can submit suitable research proposals (top-down research funding) or if research proposals can be submitted in a great range of research areas (bottom-up funding) without administrative restrictions, simply on the basis of quality and relevance. Most countries have mixed systems with a variety of funds; however, there are some important differences in the weight given here or there to various financial structures. France is a good example of a strong steering towards programme-oriented funding structures, while in Germany the DFG (*Deutsche Forschungsgemeinschaft*), as the largest research fund for universities, or the Austrian Research Fund (FWF) represent typical cases of a strong tradition of bottom-up project funding. Besides these classical funding structures – which often have been set up in the post-war period –, virtually all countries have created new special programmes and, sometimes, new research funds under

the changed boundary conditions of today (such are as for example the two new research funds put in place in France in the framework of the Innovation Act of 1999). Such new resources are often dedicated to technology-oriented research in order to foster industry-university collaborations interested in innovation. The changing balance in the allocation of research funds touches different university types and different disciplinary fields in fundamentally different ways. The humanities and social sciences, in particular, have come under increasing pressure when the new value system for research has prevailed – a funding gap made more visible by the simultaneous creation of special funding programmes for the natural sciences and for technological development.

In this complex resource landscape, collaboration strategies play a central role for getting access to virtually all funding. The high degree of competition among researchers for this money calls in fact for networking strategies that use high personal academic profiles to the benefit of research teams with "winning power". Such strategies have become increasingly important nationally; they are crucial, however, at European level. The participation in EU framework-programmes is considered so essential by national policy-makers that most countries have developed structures to facilitate networking as a key to European support. Less powerful players in the EU, such as Hungary, have particularly underlined the centrality of European research opportunities. However, such funds are also limited both in terms of the amounts available and of the range of topics they can cover; this means that universities are encouraged to develop capacities in predefined areas only.

Cooperation strategies also represent a means to counterbalance increasing pressure for competition. As Nowotny & Felt argued in 1996, the building of networks

in highly competitive areas of research can minimise risk and reduce competitive pressure. In that context, over recent years, universities have developed multiple and extensive networks in order to stabilise their position while assuring the continuity of their research over long periods of time – although funding mechanisms still obey much shorter deadlines.

Having shown the different limitations to which autonomous universities are exposed in their development of research strategies, we would like to close these reflections by looking at the flexibilities existing within individual universities. "Flexibilities" are important as they open the way to unplanned new initiatives. Two main areas of potential action can be identified. One is linked to the management of human resources and to the degree of structural flexibility this can induce in universities. The second is linked to the human resources themselves, as available in academic institutions. Focusing on the management of human resources in autonomous universities opens up a wide array of change possibilities. Considering the given unity of research and teaching in most national university systems, student flows have a real impact on the availability of research personnel. In that sense, personnel policy is yet another facet of research policy. There is a growing trend, moreover, to issue academic work contracts that are defined in time so that staff is being renewed, a precariousness often considered with ambivalent feelings. Offering unlimited contracts had indeed led to reduced motivation for innovation by creating research environments that were too stable and non-dynamic. Short-term contracts, on the contrary, are supposed to urge people to act. However, they do not encourage researchers to commit fully to a temporary working place. Although legal regulations differ in the countries represented in the study, the urge would be

to keep researchers on a longer term basis once they have reached a high level of qualification. But here too, autonomy has its limitations and universities can be forced to end the working contract of researchers in order to abide by the law. This, for example, holds true for Germany, but also in Austria where contract researchers cannot be hired in a given university over periods longer than 6 years in Austria, 12 years in Germany. The consequences of such formal deadlines for the dynamics of knowledge in well-established research networks would deserve closer consideration.

The situation of the young researchers entering the field is also of interest. A number of countries have created special positions at post-doc level in order to attract a greater number of young academics into university research. In Germany exist junior professorships that allow excellent young researchers to build their own research programme for a period of six years – right after their PhD; in Spain, positions of contractual "post-doc professors" have been created with similar objectives. Research excellence in both cases is the main criterion for selection. In general, however, the situation of post-doc positions in Europe is, on average, rather unfortunate (with some countries offering extremely bad working conditions, like Italy), a strange fact considering that the contribution of doctoral students and post-docs to the research output of universities is very high (see Eurodoc 2002). Despite this role, young researchers are asked often to work under difficult financial conditions, high time pressure and with no career openings. This is certainly an area of enormous potential for universities willing to use their institutional autonomy to reinforce their research profile – young researchers are in need of more attention in order to develop in a satisfactory way, both for the sake of the institution and of the researchers themselves.

II.2. Universities and knowledge production: changing concepts of knowledge, knowledge transfer and intellectual property

In this section of part II, we would like to take a closer look on how university autonomy – structured by new regulations and informed by older value systems – shapes the institutions' activities in knowledge production. Although, as mentioned earlier, fundamental differences exist between various types of universities in function of their research-orientation and history, there are some general phenomena emerging in the sector. We will stress three: the broadening and diversification of the concept of scientific knowledge – with its influence on autonomy and research development; the conceptualisation and organisation of knowledge transfer from and to universities; and the regulations concerning intellectual property rights.

Broadening the concept of scientific knowledge in the framework of universities

In line with the analysis of Gibbons *et al.* (1994) and Nowotny *et a*l. (2001), the interviews showed, as did policy documents and other studies, that there is a gradual shift taking place in the university system affecting both the concept of scientific knowledge and the way research is organised. What are the pointers in this direction?

Firstly, in all the countries under scrutiny – but also at European level –, consensus grows on the need for changed behaviour in classical institutions producing knowledge. Generally, they are accused to work in too closed a system to take account of societal evolutions: in other words, they do not listen to their stakeholders. As a consequence – and here universities as public institutions are particularly under attack – academic institutions need

to be made much more accountable to the public for the money received from the State: this would encourage appropriate answers to the requests of society.

From that debate were born in many countries concrete programmes aiming in particular at improved industry-university relations. The motivation for such projects is to stimulate shared investments in research, especially at a time when governments are short of resources. Thus, the share of private funding for research would increase. This goes hand in hand with recent declarations made at EU level asking for a raise of total R&D spending – public and private – to 3 % of the GDP by 2010; the objective is to make Europe the most powerful knowledge economy. University-industry programmes are also meant to make science more responsive to the needs of "society" – as expressed by economic partners. Considering that national and European funds are now available for such co-operative projects, university researchers tend more and more to enter knowledge alliances with industry. Collaborations of that type did exist already; they have gained new weight, however, and are more highly valued than before.

This idea of a closer involvement of social partners in the university system as such is also reflected in the reforms made of the highest decision-making bodies in academic institutions; in many countries, these boards and councils are now either fully, partially or at least optionally composed of people from outside the university community, people with a strong link to the university. Thus, the knowledge produced in universities is supposed to become embedded in the wider societal and political context.

Moreover, although implicitly, there is a growing awareness in established power structures that chosen orientations and alliances are but of a temporary charac-

ter. This was certainly true also in the past: today, however, the "time factor" has become a conscious element of those reforms with strong experimental dimensions. Thus, change does not affect so much the knowledge itself but rather the processes of its production – or, better, the conceptualisation of these processes.

Our enquiry also showed that institutions do not only develop along international lines – even if superficially this might seem the case –, but that they set up resistance strategies around fine-tuned national differences too. As they play on their local specificity, what actually happens to research in given institutions is very much the result of local political negotiations. Thus we would agree with Bleiklie and Byrkjeflot (2002) when they say that "periods of transition are characterised not only by the introduction of new values, but also by a changed ranking order between established ones. Such transitions often imply that the political game, the actors' roles and their strategic positions are redefined." (p.528) In that sense, the recent reforms and their impact on research in universities do not simply reflect a shift away from a "merit-and-truth-oriented conception" towards a "utility-conception" of research but also a complex negotiation between different positions which takes place in many different settings and at different moments in time.

Finally, let us make a point in the long-standing debate about the importance of inter-disciplinarity and boundary-crossing for innovation in science. Without any doubt these issues are on the policy agenda and are probably the issues most referred to at the rhetorical level. However, as most interview partners underlined, when it comes to career promotion or to employment rewards, to the definition of quality practices and criteria, the classical indicators linked to disciplinary structures still prevail. This gap between rhetoric and reality will

need to be bridged if universities are to develop fully over the coming decades.

Knowledge transfer: where, how and carried out by whom?

While knowledge transfer has always taken place in both directions between academic institutions and other parts of the knowledge intensive sector, the recent reforms as well as the debate which accompanies them have given this issue a much higher visibility. The argument focuses on the better use of knowledge produced in universities: should not the potential interest of knowledge for future applications be already accounted for in the production of new ideas? Conversely, should not researchers become more aware of the concrete value of their knowledge outside their direct research environment? As autonomy translates in the university's positioning in the wider knowledge environment, many of the countries under scrutiny no longer leave knowledge transfer to the individual researcher: on the contrary, they organise it.

In this context, innovation becomes a key notion as it points to a more technologically oriented vision of what "useful" knowledge is. This utilitarian approach fits better some national traditions (like in France), but also reflects the fact that external funding comes from sectors mainly active in technological developments of different kinds.

The national discussions are of course embedded in the international rhetoric – most recently the discourse on a European Research Area. As mentioned in the introduction, the main idea is that universities are key contributors for a competitive knowledge economy, first when producing knowledge adapted to society's development goals, secondly when educating students to be-

come tomorrow's highly skilled "knowledge workers". It should not be overlooked that these changes have not appeared all of a sudden; the shifts of emphasis began long before these issues found legal expression at institutional level.

The solutions adopted in various countries differ widely although they pursue similar objectives. Different research cultures and traditions, different ways of handling intellectual property and the different weight attributed to the issue explain national divergences. A few examples can illustrate this diversity of solutions.

In Germany, knowledge transfer has gained much popularity in the policy discourse and a kind of "market enthusiasm" characterises German science policy documents. As a result, many universities have introduced so-called "technology transfer offices" that seem, however, to show uneven success. Next to administrative support, a number of incentives have been arranged to encourage university-industry co-operation. However, at the same time, academics constantly harp on the Humboldtian ideal and express fears about an over-emphasis on the need for applicable and context sensitive knowledge. Could not interesting and innovative long term developments be by-passed as research gets focused mainly on contemporary, immediate and already clearly identified needs?

Spain too has created "Research Results Transfer Offices" (OTRI) that promote in each university the transfer of knowledge to companies while fostering collaboration with industry. Organised as the national network of these transfer offices, *RedOTRI* has developed an advisory function to public administration concerning the collaboration between university and industry.

The latter is also the focus for similar activities in Austria. Special programmes have been launched by the

respective Ministries in order to encourage knowledge transfer, "Scientists for industry" and "Scientists found firms", for example. The universities as such, however, are not specially active in knowledge transfer issues, but there are already some exceptions and there is growing awareness about the need to engage in such initiatives. As underlined by Schartinger and others (2002), who investigated the Austrian situation of university-industry linkages, the issue should not be limited to research contracts and patents only. Knowledge transfer takes place in many other ways like training and personal mobility, that are more difficult to monitor.

In Hungary, there is strong emphasis on the need for universities to contribute to the development of a knowledge economy. Policy measures thus try to encourage customer orientation and the business utilisation of academic "knowledge products" in order to reinforce the competitiveness of the economic system. To this end, the so-called "co-operative research centres programme" has been launched. It aims to foster the setting up of joint research units between university and industry. The idea behind the creation of such independent centres is not only to increase the entrepreneurial spirit in those universities fostering transfer activities, but also to move teaching closer to research.

In France, a variety of measures have been taken to ensure knowledge transfer and innovation. In fact, France shows very well that the shift of the relation between industry and public academic institutions has already started in the 1980s (see for example Mustar & Larédo 2002). Indicators of this transformation can be traced not only in the financial structures but also in the increased number of publications with public-private dual authorship. The most recent step underlining the importance of these collaborations is the Innovation Act (passed in 1999) that

centres "on the development of 'relations between researchers and companies' and 'collaborations between public sector research and companies'" (cited after Mustar & Larédo, 2002, 66). To this end different new organisational settings have been developed: they allow for flexible and innovative working environments in innovation intensive sectors. Thus, for instance, "incubators" have been set up, that partly involve universities and other research establishments, in order to create innovative enterprises.[11] Furthermore research & innovation networks were founded (RRIT) and, in early 2002, the Ministry announced the establishment of SAICs (Services for industrial and commercial activities) in all universities. At university level, units have been put in place to "give value to research results" (*valorisation de la recherche*).[12]

Intellectual property rights (IPR[13])

The possibilities for patenting knowledge and procedures developed within universities was taken up already in the 70s in the US and as early as 1980 this domain was regulated in a completely new way through the so-called Bayh-Dole Bill. Through this act, universities and colleges could become important actors also in the economic domain and they began immediately to develop internal structures and expertise in order to be able to engage in the patenting and licensing of new knowledge. In Europe

[11] See for example: http://france.Incubation.free.fr/

[12] A nice summary of the basic elements of French innovation policy can be found under www.infoexport.gc.ca/science/FR_2002-fr.htm

[13] For a comparison between France, Italy and Spain with regard to patenting activities of universities see Cesaroni/Piccaluga (2002).

this development started much later and in the late 1990s most reports still stressed the fact that European universities have been lagging far behind their US counterparts with regard to building industry-university co-operations, but also to protecting and exploiting intellectual property (see for example Howells & McKinlay 1999, Etzkowitz et al. 2000).

Although, over the recent years, attitudes towards these issues have gradually shifted, there is still within universities hesitation (with the exception of certain research fields) to engage fully in these domains. However, there is at the same time large convergence among the countries investigated in the increasingly important role universities can attribute to intellectual property rights; the issue has definitely become more important and has also entered research assessment –, even if some fundamental differences remain. In fact, we would like to distinguish three different groups of countries, which handle the issue of intellectual property rights with regard to knowledge produced in universities in rather different ways.

The first group are those countries where the IPR remain with the individual researcher. And even within this group there are very different stories about how this domain was and is regulated. To start with, Italy: there, the IPR used to belong to the university as an institution; however, under the new legal conditions, the rights do now belong to the individual researcher. This is seen as an encouragement for the researchers' entrepreneurship. In Austria researchers have to announce patentable inventions to the rectorate of the university. Only if there is no patent application from this side within three months, the researcher can then keep the intellectual property rights. In Finland, the IPR also remain with the individual researcher except when the invention has been made by a

team. Then, the university applies for the patent and the sharing of the financial income is regulated by a contract between the people involved. In Greece the IPR also remain with the individual researcher.

The second group consists of those countries where the university holds the IPR. In the case of Germany, through a new legal regulation, the university researchers lost the so-called "Hochschullehrerprivileg", which meant that the IPR remained with the individual researcher,. The new regulation implies that the university takes care of patenting through the newly institutionalised offices for technology transfer and that any financial income is shared between the university, the researcher and the transfer office. A similar system is in place in Spain, where the institution also holds the IPR but owes financial compensation to the researcher. Only in the case of the UK does the IPR remain with the university without any compensation for the knowledge worker. The Netherlands also belong to this group, the institution holding the patent. The issue of IPR was discussed on a national level by the Platform for University Patent Policy, which consisted of experts from different research fields as well as of members of the Office for Industrial Property and Industry. Universities reacted to this by setting up their own platforms. In the Netherlands in general the frame for handling IPR is set at national level, however, universities are also expected to develop their own internal policies with respect to patenting and knowledge transfer. Like that, they can handle the IPR issues individually with their researchers and be responsive to the different needs present in such a diverse system. Furthermore, patenting is not necessarily seen as a central activity for universities and we even found an explicit recommendation by the Science and Technology Advisory Council saying that patenting should be left to industry.

Finally, In Hungary IPR issues are regulated according to the type of contract under which the research has been carried out and thus different solutions can be found.

To sum up, solutions to similar problems can turn to be fundamentally different. While Italy moved away from IPR belonging to the institution and gave it to the individual researcher, Germany decided to go exactly the opposite way. To speculate what impact the one or the other solution will have on research – as well as on the researcher's motivation – is difficult. Too little in-depth research is available on this issue. Furthermore, the ideal of patenting and the reality as regards the income it creates for universities sometimes prove to be quite contradictory. As was underlined by one of our interview partners in Finland, university revenue from patents is extremely low and it can even become a net cost factor rather than a source of income!

To close this chapter, we would like to address the idea of the sustainability of knowledge systems, which regularly surfaced during the discussions around the issues of knowledge production, transfer and property. Behind it stood the vague idea that knowledge is becoming increasingly – be it explicitly of implicitly – tied into the economic and societal context in which it is developing. Thus, the narrowing down of the areas that are identified as being of key-importance, the fact that selectivity is seen as an important quality in research funding but also the assessment exercises which shorten the time scales in which results need to be presented and which appear to reinforce certain more conservative strategies in research (see chapter II.3.) seem to threaten the "ecological balance" of the "knowledge system". In a way, we are now drawing our resources from a long period of rather open research, when financial considerations did exist – but

not in the omnipresent way of today –, when basic financing of universities allowed a certain amount of basic research even without third party money and when accountability did not fix the rules of the academic game as it tends to do at present. This is not a plea against the introduction of selective financing modes or of evaluation procedures; rather, it is a call for institutions to be aware of their long-term vision even in situations of great pressure, thus putting in place policies within the institution that can balance these developments.

II.3. Accountability and quality assessment in research

Accountability and the quality assessment of innovation are excellent pointers to the potential consequences – direct and indirect – of increased university autonomy on research. If governments have granted more freedom to universities in the handling of their affairs, i.e., their development, they have also set up national structures to control and academic accountability and to monitor the quality of university research. This shift in responsibilities is not specific to the research system but is part of a wider search of "value for money", a neo-liberal standpoint now imposed on many sectors of public life.

The quality of the universities' "output" and how to achieve it in single institutions and in national university systems has thus become a core argument in academic strategies of development as well as a motor for institutional change. Before surveying the situation as it has recently developed in the countries under scrutiny, may we remind the reader of some of our basic assumptions. Firstly, we believe that quality assurance mechanisms are meaningful indicators of society's expectations vis-à-vis the universities and their intellectual output – in areas where academic values often remain implicit. Moreover,

through the criteria used, the indicators developed and the different weighting of a variety of aspects of universities' tasks, an "ideal institutional profile" can be constructed, which could strongly influence future options in higher education development.

Secondly, in asking the questions "who is involved in putting the quality assurance mechanisms in place?" and "who is defining the basic criteria along which to evaluate?", we can size up the potential role of stakeholders and their relative power in the new university landscape.

Thirdly, the time scales used in evaluations betray the policy makers' understanding of the functioning of the innovation and reproduction cycles in the universities. The shorter the cycles of evaluation are, the more pressure is exerted on the system and the more invasive are the controls. To be noted that – for simplicity's sake – there is a risk that superficial and "easy to measure" elements become the core indicators of quality assessment, thus reducing the evaluation to a kind of intellectual book-keeping (number of students, of papers, amount of third-party money, etc...).

Finally, we consider that assessing the quality of research is not simply an external act but that it can influence or interfere with the core values of the innovation system. Keeping all this in mind is of crucial importance if we want to weigh the real impact that increasing university autonomy may have on research.

We do not intend to look into the origins of the national systems of evaluation nor to study their impact on the development of research systems as a whole. Enough has been said already on science policy actions and quality assessment; less is known about their concrete consequences – as reported by Gläser and others in a report commissioned by the German government. So, we will discuss the main points raised in our interviews and per-

ceived as most critical to understand how quality procedures intrude on research development, and to what degree the autonomy of research is realised within autonomous universities.

There was a shared analysis that the price paid for autonomy was a growing commitment to a "culture of accountability". We use the term culture because it helps understand how and up to what degree the detailed formal structures and mechanisms currently in place percolate down into day-to-day practices – in other words, how they reflect and inform the researchers' value system in universities. Accountability and quality assessment cannot be reduced to the perfection and smoothness of the proposed procedures or the declared intentions of those who set them in place. It is crucial to see how the system is experienced, how much the people think it intrudes into their work environment and what impact this might have on the development of their own research – when done in universities. It is also important to consider that evaluation systems, once introduced, often take more than a decade to become embedded, culturally accepted, i.e., to become an integral part of the quality culture in a specific institution. When comparing different national quality systems and their impact, the question of their maturity is also central as many of them have existed only for a relatively short period of time: they are not fully developed yet and often in a phase of experimentation still.

To start with, we will briefly sketch the way different countries introduced quality systems, on what basis they created them, and the difficulties identified so far. As a second step, we will point to a number of transversal issues across these different contexts in function of their impact on university autonomy and quality assurance.

The countries dealt with in this study can be divided into three groups with respect to their approach to insti-

tutional evaluations of university research (see also Campbell 2002). The first group embraces the UK and the Netherlands. Their evaluation systems have a rather consistent and developed praxis – aiming at systemic assessment and improvement mainly. The second cluster consists of those countries with a pluralistic approach, countries that use in parallel different methods and concepts – often taking account of varied situations. This group consists of Finland, Germany, Austria, France, Italy and Spain. The last group brings together those countries that, so far, have little experience of evaluation in university research, nations that test new approaches. Hungary and Greece belong to this group.

The oldest and, formally, probably the most elaborate system of research assessment exists in the **UK**[14], where the Higher Education Funding Councils (HEFCs) are responsible for carrying out research evaluations. From 1986 onwards, so-called *Research Assessment Exercises* (RAEs) have been regularly organised, the results of which are directly coupled with the allocation of virtually all research funds to the various universities. "The purpose of the RAE", a documentation underlines, " is not just to enable funding to be allocated selectively but also to promote high quality." (HEFCE 2001, 2) The time interval between such exercises has varied so far between three to five years: research quality is not evaluated in the university as a whole but in assessment units that correspond to research fields. The system is based on "informed peer reviews". The "quality" is expressed in terms

[14] Information on the British evaluation system can be found in: Henkel (1999); Talib/Steele (2000); Curran (2000); Elton (2000); Koelman/Venniker (2001), Campbell (2002), HEFCE (2001), Theisens (2003); Geuna/Martin (2001).

of marks that enter the formula for calculating financial support. The debates on the pros and cons of such structures never ceased since the system was introduced; indeed, numerous smaller or bigger adjustments were brought in but others are still required by the universities. However, in an overall judgement, despite strong criticisms about procedures, researchers have the subjective feeling that the quality of research in British universities has improved thanks to these exercises.

The system is intrusive at various levels: firstly, it couples mechanisms rigidly, thus not reflecting adequately the complexity of the tasks which universities have to fulfil; there is an imbalance in the evaluation done of teaching tasks compared to that made of research; this lack of flexibility leaves too little space for creative development. A strong orientation towards quantitative indicators – even when balanced with peer evaluations – seems to incite researchers to adapt to theoretical norms rather than to improve the quality of their output. Furthermore, these research assessments are costly undertakings and can represent a kind of negative investment for those institutions that are not among the best, since there is a high risk that they will never get their money back in the form of adequate financial support. Finally, there is a high degree of unintended selection and reinforcement mechanisms that tend to develop once the system is in place. Thus, very good groups will attract money and, as a consequence, better staff and students, who, in turn, will increase the institution's chances to have access to more grants. This leads to what the sociologist of science Robert Merton (1985) has called the Matthew effect (those who have will be given more, and it will be taken from those in misery).

The **Dutch[15] solution** for the quality assessment of university research is probably the most elaborate as it tries to be comprehensive while remaining also open to the negotiation of procedures throughout the evaluation exercise. In the Netherlands, it is not a government agency that organises the evaluation and defines the assessment criteria, but VSNU. This umbrella organisation of the Dutch universities is in charge of setting standards, methods and criteria (see VSNU / NWO / KNAW 2003). This clearly changes the relation between the body responsible for the assessment and the research institutions being assessed as VSNU is not considered to be an institution foreign to the university system: in short, assessment belongs to the academic community it evaluates. Such a system of quality assurance that heavily relies on qualitative methods and peer review procedures understands evaluation as a process very much embedded in the universities themselves. The government plays the part of some meta-level observer of the process that checks that evaluation results are taken in full consideration when universities envision change.

The Dutch combine various approaches of the work of higher education institutions: the traditional notion of quality linked to quantitative development, like the publication output; the relevance of the produced knowledge in function of its up-take and distribution; the processes within the institution (the input/output relation), as well as the compatibility of the organisation's work with its self-defined aims, i.e. the quality of its management and

[15] Information on the Dutch research evaluation system can be found in: Rip/Van der Meulen (1995), Geuna/Martin (2001), Campbell (2002), Boezerooy (2003). For a detailed description of the actual procedure itself see the so called van-Bemmel-Protocol: VSNU / NWO / KNAW (2003).

leadership. There is no strict coupling of the outcome of such assessments with financing procedures although evaluation results play a central role in the discussions of budget distribution. Self-analysis and institutional learning are thus understood to be key elements of the exercise. May we add that a recent change has occurred, namely that universities themselves are to be responsible for their own quality assessment exercises, – a process now somewhat standardised by the "van Bemmel Protocol". Universities then have the freedom to add criteria and define areas which they consider to be of specific relevance to their own institutional development and where assessment is needed to make well-informed strategic decisions. Thus, in a certain way, the importance for universities to cultivate their differences is accepted while, at the same time, a common basis is retained. From that point of view, one is ready to play some elements of comparability against the universities' active shaping of their own institution. The time horizon for such external evaluations is six years, with internal evaluation taking place every three years in order to accompany the process.

In the second group of countries, that of heterogeneous evaluation practices, **Finland**[16]**,** in 1995, along with major university reforms, has established a Council for Higher Education Evaluation (FINHEEC) to carry out different kinds of evaluations, both in sectors of research and teaching. Until then, there was no systematic culture of evaluation in the universities. Indeed, assessment of the quality and relevance of whole research fields at country level had been done already to situate resource allocations for various projects; furthermore, individual scientists or research groups had experienced evaluation pro-

[16] For a short description of the Finnish evaluation system see Geuna/Martin (2001), Husso et al. (2000), Kaukonen (1997).

cedures; the process, however, was not systematic and did not address institutions as a whole. Suggestions were made to create a performance-based system of funding allocation for universities, at least little after the setting up of the new procedures; the model was the UK. "Management by result" was the name of the game, although only a part of the money allocated was to depend on performance indicators (Kaukonen 1997, OECD report)... Such an approach was nearly unanimously criticised by the universities that also condemned the fact that the Academy of Finland would be entrusted with the evaluation of the university system (an idea that was to reappear in Austria too). The argument focused – often by making negative reference to the British experience – on the fact that quantitative indicator oriented assessment (when closely coupled to funding) risks becoming rigid and dogmatic, thus negatively influencing the research dynamics of the country.

As a result, the system now being implemented – like in the Netherlands – does not directly link assessment results with governmental financial allocations. Evaluation is understood as a tool for the systematic improvement of academic activities, a motor of the negotiations deciding the directions to be taken by university development.

In 1985 already, **France**[17] created the National Evaluation Committee to assess independently the country's institutions of higher education. After some twenty years, there is little evidence that evaluation outcomes have had a large impact on the financing mechanisms or that they influenced the reorganisation of the university system. In fact, for research, different units in the system (mainly labs or individual researchers) are being evaluated

[17] For reflections on the French research evaluation system in general see: Larédo (2002);

but not the universities as a whole. Thus negotiating the four year budget contracts with the central government is not linked to any systematic research assessment exercise. In that context, it is to be noted that, contrary to many of the countries here under investigation, France had no hot debate on quality assurance matters over the recent past.

In fact, in the French system of university quality assurance, rather different and partly contradictory forces are at work (both within the university system as a whole or within each single university). This did not help finding overall solutions for the evaluations of a university system characterised by a great diversity of higher education institutions nor did it lead to the transparency necessary in quality matters. Two examples can illustrate the difficulties encountered: firstly, as research within universities often draws on the resources of laboratories mixing researchers from the universities and investigators from the CNRS *(Centre National de la Recherche Scientifique)*, goals and assessment in such laboratory or research group reflect rather different approaches. While university researchers combine research and teaching (and teaching loads are rather heavy, in particular for younger researchers), investigators with CNRS contracts do focus on research only. Secondly, in the French university system, access to academic positions is regulated from the centre through national commissions organised along disciplinary lines. These commissions evaluate whether a person, in principle, has the qualifications to become assistant or full professor. Such a national procedure has a powerful impact on the definition of research fields and on what is considered to be relevant and good quality research. As single universities can only draw on researchers who have gone through this centralised pre-selection process, the mechanism has a strong, though invisible, influence on

the definition of quality issues and on the shape of the research landscape.

By a 1993 law, **Italy**[18] introduced a system to evaluate Italian universities that was adjusted in 1999. Before that, there was a period of discussion and experimentation of quality assessment. The 1993 law – although in rather vague terms – asked for the creation of internal evaluation units in each university: they would define reference parameters for evaluation and report findings to the Ministry responsible for the universities. In 1996, this rather bottom-up approach was streamlined through the setting up of an *Observatory for the Evaluation of the University System* (later replaced by a *National Evaluation Council*); this institution was to do comprehensive evaluations of the institutions of higher education while receiving the universities' yearly reports. The focus of these evaluations was clearly understood to be the structures in which research takes place rather than the individuals making the research. On a mid-term basis, the idea was to use such evaluations to help redistribute the financial means available from the State and to set incentives for improvement – so far, however, little experience has been gathered in this respect.

Having bodies internal to the university (although supposedly independent) that are responsible for evaluations that might influence financing caused serious tensions. This explains why the system was put in place rather slowly and why universities tried to keep as much control of internal evaluation units as they could. Within universities, the lack of information systems as well as the quasi-inexistent quality culture in the institutions made it

[18] For the Italian university system with regard to quality assessment see: Rizzi/Silvestri (2002), Biggeri/Scarpitti (1998), Geuna/Martin (2001).

extremely difficult for the system to come up with well informed yearly evaluation reports. As a consequence, many universities considered this exercise more of a burden than a chance to make quality a central issue for future development.

The 1999 adjustments took these problems into account by offering a stronger basis to the evaluation units within the universities (in fact, by giving them operational independence from the university). This was to lead to a network of university evaluation units working in close connection with the National Evaluation Council which, in turn, would provide support to the Ministry when making decisions about university financing. The idea consisted in the creation of a joint evaluation system. This more integrative evaluation system was to combine with three-year university development plans.

Critics, however, underline that too few accompanying measures were taken to allow for the assessment system to develop efficiently: no clear standards were defined on how to proceed in such evaluation exercises – whose status remains vague. University assessment units still play a dual role as the mouthpiece of the institution, on one side, and, on the other, as a partner in national policy-making – a double role that proves nearly impossible to play. Thus the Italian evaluation system seems characterised by strong tensions between the evaluation units and their respective universities, while there is no clear understanding of the division of roles between the National Evaluation Council and institutional evaluation units (this has never been clarified by law); in fact, each university is quite free to define its own approach to quality. As a consequence, evaluation has not been implemented as a mutual learning system, but rather as a formal procedure, which is not necessarily supported or taken seriously.

In **Spain**[19], major university reforms started in 1983 with the approval of the University Reform Act (LRU); in 2001, it was replaced by a strongly contested new university law (LOU). The peculiarity of the Spanish system is that universities depend on 18 different authorities, one national and seventeen regional ones – each with a different idea of what a university is or should be. Like in many systems, the budget is allocated by the regions as a lump sum that the university distributes internally. However, if the region is the dispensing authority, it has little influence on the largest part of the budget, i.e., the salaries that are regulated at national level. In the LRU already, the need for quality assurance mechanisms had been recognised, although it took some ten years to set up the system, at first as an experimental programme for the *Assessment of Quality in the University System*. On that basis, a Programme for the Institutional Assessment of Quality in Universities (PNECU) was launched later under the responsibility of the Council of Universities; it lasted for six years. This programme covered all aspects of university activities – including research – and aimed at helping institutions to improve their potential for development. Its objectives were to raise awareness of the importance of quality monitoring in universities, to develop basic criteria common to all institutions, to build a platform for improved decision-making by the Ministry and to inform society about the quality of academic work. A Second Plan for the Quality of Universities followed from 2001

[19] For the Spanish university evaluation system see: Vidal (2003), Jiménez-Contreras et al (2003), Vidal/Quintanilla (1997). An early version (1995) National University Quality Assessment Plan in English can be found at:
www.hut.fi/Misc/H3E/wg2/Spain_Quality Assess.html

onwards. All in all, numerous reports were written, lots of time and resources were invested but, as one analyst stressed, "quality as a culture has not yet developed among university staff" (Vidal 2003, 305) – perhaps because there was no direct link in both programmes with university financing by the regions.

The 2001 law decided to reflect the duality of the system by introducing quality assessment at both levels, on one side by setting up a *National Agency for Quality Assessment and Accreditation* (ANECA) and, on the other, by creating *regional agencies*. But how to articulate both levels of competencies has proved the main difficulty, a problem mentioned both in our interviews and various policy papers. The law does not specify which are the responsibilities of the national and regional agencies. In fact, such a double assignment of similar tasks has happened in other countries too, when national and regional levels have similar responsibilities on common issues. In Spain, moreover, when the law gave the *Social Council* the highest authority in the regional steering of universities, it emphasised the institutions' role for the region. But this has had more impact on teaching activities than on research which, to a large extent, still depends on classical academic evaluation routines.

In the case of **Germany**[20]**,** the debate on evaluation has been intense for a while and, for research, the German research council has played a central role in the discussions; however with no tangible result so far. Like in Spain, federal structures give the *Länder* a central role in resource allocation to universities; regional authorities decide of the budget as a block grant supposed to cover ba-

[20] For a short overview of the German situation see: Huisman (2003), Enders et al. (2002), Gläser et al. (2002), Campbell (2002), Campbell/Felderer (1997), Geuna/Martin (2001).

sic expenditure and also staff resources. Large scale equipment, however, is funded jointly by the *Länder* and the central State. For university research, the largest part of third party funds comes from the German research fund (DFG), an autonomous body jointly funded by the *Länder* and the *Bund*. These additional funds are subject to precise evaluation criteria. Universities as such are also being evaluated but with no link made to funding (Daniel& Fischer 1990). During the 1990s, publicly funded research institutions, however, had to go through evaluation exercises that sometimes had severe consequences – like the closure of specific institutes.

The allocation of basic funds to universities is not linked to research performance but, rather, to the teaching tasks – which (to be assessed) require an understanding of the time spent by staff on research. Recently, some *Länder* tried to allocate additional funds on the basis of performance-related criteria; yet, this remains an exceptional procedure. In the German case, no overall evaluation of universities as a system has taken place and many academics express some reluctance towards assessment as a process. "Until recently it was generally assumed that such measures (regular evaluation procedures for higher education institutions) were unnecessary because the peer review system permitted the proper allocation of research funds" (Enders et al. 2002: 100). It was and is still seen in contradiction with the Humboldtian university culture. Campbell and Felderer (1997) underlined that, among German academics, competition (as a result of assessment) is not considered to be a factor improving research quality. Classical evaluation processes are also accused of reinforcing existing strengths rather than helping create a climate of innovation and risk taking. Focusing on past performance, such procedures might fall into the trap of not seeing the importance of potential futures. In Ger-

many, some even go so far as to argue that state-enforced evaluations are anti-constitutional as they could intrude on the freedom of research. This can explain why, so far, the important actors in the research evaluation debate still remain individual universities deciding of their own free will – like the *Freie Universität Berlin* – to perform research assessment exercises and use them for internal purposes.

A breakthrough in this situation could occur after the adoption in 1998 of a major reform in the Higher Education Framework Act – at federal level. Competitiveness is the key motto that opens the possibility to evaluate both research and teaching performance; it also points to different forms of resource allocation. But, above all, the reform makes clear that individual professors have no longer the power to refuse participation in such procedures!

The last country in this group is **Austria**[21], which introduced teaching and research evaluations as an integral part of a new university culture with the 1993 bill reforming the Austrian university system. However, if the law was rather detailed for teaching, it was not very precise about the assessment of research. In fact, each single university is supposed to develop its own procedures. So far, some evaluations of research units have taken place in a few universities, but with no clear consequences on the allocation of resources. Moreover, the indicators used in such evaluations and their weighting remain vague: so, there is little transparency. The most recent reform – UG 2002 – does go one step further by setting up a national body that will not only be responsible for evaluations but also for the definition of common criteria. These evaluations will then have some influence on the global budg-

[21] Short description of the Austrian evaluation system can be found in: Beerkens (2003), Campbell (2002).

ets, as basic information for the contract negotiations that each university is supposed to have with the government. It still remains to be seen what impact this new agency will have in reality – depending on its members and on the mechanisms, implicit and informal, that can influence the way policy decisions are finally being made.

The third cluster of countries – with little or no evaluation experiences in the university system so far – are Hungary and Greece.

Looking at **Hungary**[22]**,** one has to consider the major shifts in the university context that followed the change in the country from a centrally-planned to a competition oriented economy. The first step therefore was to restore an understanding of scientific peer judgement which would not be subordinate to external pressures. In that sense it was important to establish a peer review system for the grants available for research. (Hangos 1997) It is interesting to see that the focus of evaluations was first on the institutes of the academy of sciences and only then on the universities. This could be explained out of the particular history of the role of these two institutions. The debate is also difficult as the financial situation is rather bad and definitely worse than in any of the other countries investigated here. HAC (the Hungarian Accreditation Committee), a national evaluation agency, takes care of developing an overall structure of quality assessment, but for teaching only. The quality assurance of research is thus left mainly to the initiative of individual people or groups. Some universities have at least started to collect some quantitative indicators in order to be able to take better decisions, however any qualitative debate remains marginal. Hope is put in European inte-

[22] See also from a comparative perspective Geuna/Martin (2001).

gration; through participation in EU programmes, such criteria will enter the system, become a part of it and change it from the inside.

Finally, only very little can be said about the case of research evaluation in **Greece**. So far no comprehensive national system has been developed even if the government understands that assessment exercises represent an important tool in the making of the Greek universities' competitiveness vis-à-vis their European counterparts. Thus, work has being carried out over the past few years in order to develop an evaluation system both for the research and the teaching sides of university activities, but it has not been implemented so far. Indeed, as was described to us, there is still reluctance among universities to implement such quality assessment processes.

What are the observations that we can make as regards the link between increased autonomy for the university as an institution and the way the autonomy of research is expressed? This subchapter has closely investigated quality assessment and accountability structures in Europe to see confirmed our introductory remarks: assessment and quality are places where the new value systems are implemented and where national governments can express their ideals. At the same time, it is clear that in most countries increasing autonomy for universities went hand in hand with the retreat of the state as a central financier of the university system; thus, the allocation of budgets and the acquisition of third party money have become central for the further development of the system.

As a conclusion to this chapter, we would like to raise a number of issues which need attention from the side of policy-makers within universities and in governments, and which in part also would need further investigation to judge their impact.

Firstly, it is interesting to observe that in virtually all national contexts investigated – although in rather different forms – **national evaluation agencies** have been established in order to take care of this activity. Evaluation of academic output has in a certain way – along with the restructuring of the research and teaching – become a profession in its own right (House 1993, Felt 1999). These issues are no longer to be left to the international scientific community or to the individual institutions as such. Much more, evaluation has become an issue for building the national know-how. These agencies are involved in both the assessment of a person's qualifications, but also of structural features. Thus, they become powerful players in reshaping the universities, while appearing in the rather remote position of "objective" quality assessors.

Here however appears the second problem which was identified in a number of cases, namely that within the overall systems of research evaluation a number of different and partly **contradictory forces** confront each other. Tensions can appear between regional and national levels as is the case in Spain, but also because people with different labour status (and thus submitted to different value systems and working realities) collaborate in research projects on a continuing basis, as s the case in France with CNRS staff in universities. Along with the national evaluation agencies, a number of countries (such as Italy) have put in place evaluation units within universities, however leaving it unclear if these are to be seen as part of the university (representing its interest towards the national funding bodies) or if they are supposed to be a sensor for the evaluation agency within the university. From that point of view, quality assurance within universities is fundamentally different from quality assurance in private companies. In general, results of university evalua-

tions do not remain within the single university but move to the policy level and thus are dispersed widely. They are in most cases not used as internal improvement tools, but rather to position universities with regard to various partners. Rankings between the research quality of universities (as published in Germany by the DFG or the HEFCE in the UK) are but one outcome of such approaches. As a consequence, universities develop strategies to hide their weaknesses and to overemphasise their strengths, a strategy which hinders the open handling of any major improvement processes.

This issue is closely linked to the fact that in most countries the evaluation mechanisms have been introduced in parallel to severe **budgetary cuts**. This explains why people tend to be rather cautious towards such quality assurance tools as they see them as means to intrude directly in their work environment. Evaluation is thus often seen as an instrument of restriction and control rather than as an instrument of development and negotiation. The latter, however, would be the most important aim to achieve. The British case is often cited as being an icon for the way in which evaluation systems can stimulate both positive and destructive energies.

Processes of **adaptation to evaluation criteria** represent another issue to be monitored. The British case has also shown rather nicely that universities are capable to adapt to the external pressures, even at a high price – as some analysts would argue. On the one hand, institutions are increasingly capable to meet the standards required to be labelled "excellent" and thus the limited budgets have to be shared among an increasing number of players. On the other hand, even very good universities are not good enough anymore to acquire additional funds and thus, for them, the investment in costly evaluation procedures does by no means pay off. In that sense,

participating in assessment exercises becomes a strategic choice of investment and is no longer seen as a process whose aim is internal quality improvement.

Another issue that came up regularly in many national contexts was the issue of **conservatism linked to a rigid evaluation culture**. Taking risks is discouraged in a system where there is a strong coupling between research assessment exercises and institutional funding. In a study of different elite universities, Ingo Liefner (2003) points out that, on one side, people underline that such a system can foster quality and lead to increased activity in the research system; however, on the other side, it also seems to change people's attitudes toward risks: "people tend to stay within their academic fields and avoid projects with uncertain outcome. (…) The use of both indicators (publications and citations) for the evaluation of research puts pressure on scholars to publish frequently in prestigious journals. (…) Hence, if publication is crucial for sustaining the funding base, scholars are unlikely to take the risk of changing their field of research" (Liefner 2003: 480).

The topic of **timing in evaluations** also needs closer consideration. How long should evaluation periods be in order to allow for reasonable judgements of the output while at the same time taking the funding procedures for universities into account? In general the trend towards increased quality assessment gradually forces researchers into different working conditions, as they have to plan their projects on a much shorter time scale, considering that output needs to be presented on a constant basis in small "portions", so that they may be able to justify the use of resources regularly. Thus, long term visions have to be translated into fundable smaller packages (at the risk of being funded for only part of them), thus loosing a more complete vision of the picture. Many analysts

have hinted at the fact that these structures on the one hand increase the consciousness of the quality of research, but on the other hand make people act much more cautiously: in the long term, this could hinder innovation.

Then there is also a shift to be observed concerning the **moment when evaluations take place**. While traditionally much of the quality assessment in research has been made *ex-ante*, now the assessment mechanisms are concentrated on the output side. Thus, there is a clear "value for money" debate, which has not been so strongly present earlier. We could critically remark that much more attention should be devoted to the processes within universities that transform financial and other sorts of input into tangible research outputs. This is of course much more difficult to achieve than developing indicators and following them, but it is the only way in order to understand universities better – as research institutions – and to improve the working procedures in them.

An interesting **contradiction** became apparent between the public **rhetoric** about science and its importance for societal development, which has shifted along with the international discourse in this domain towards stressing the importance of practical applicability of research results, of university-industry collaborations as well as of intellectual property rights, and the **criteria applied in evaluations** which are in many cases still rather classical ones mainly being based on publications (and partly on citations).

Finally, it is interesting to note that in a small number of countries questions of **fraud and scientific misconduct** have been addressed under the heading of quality assurance. Indeed, as the pressure rises in the research system, the number of cases where the basic rules of

knowledge production are being transgressed seems to rise. Thus, in a number of universities – and also of funding bodies – more explicit rules and regulations are being developed in order to replace the more implicit agreements that used to prevail within the international scientific community.

Concluding Remarks

What are the challenges the European universities are facing should they want to become or remain key players in the emerging knowledge economy and society? How far does the increasing autonomy of higher education institutions and the changing milieu in which they have to position themselves impinge on the research they undertake? How can they, in a sustainable manner, keep a leading part in all their activities, be they the production of knowledge, its transmission through education and training, its dissemination to the wider society or its transformation into various applications?

In the final part of this study, we point to eight items that rise from the case studies; they determine key areas for academic institutions to debate, meditate and rearrange so that universities actively shape their future. May we remind once more that, to understand the paths along which universities develop, one must consider not only the explicit, formal side of change but also the implicit forces present in everyday life, both shaping the strategies developed by institutions to face new boundary conditions. Universities, although organised at national and regional levels, are also embedded in a European environment – which tries to impose certain policy orientations; at the same time, they are asked, more and more, to set up internal policies to steer their further development towards a recognised status in the global network of insti-

tutions of knowledge. Universities are thus facing "glocalisation": they have both to develop a strong local presence and use this grounding as a kind of capital when positioning themselves in global networks. In other terms, if we observe an increasing harmonisation of discourse – as if all universities were facing similar challenges – the university landscape is characterised simultaneously by a bewildering and seemingly growing heterogeneity (as shown in organisation, governance and operating conditions). Above all, however, universities have different cultures and thus experience differently the new discourse and structures in their day-to-day context. In that sense, beyond the macro-level observations we have been able to offer, it is crucial to look also at universities at the micro level in order to understand how rhetoric turns into procedures and measures that influence institutional activities such as teaching and research. In fact, it is not so much the regulatory level that shapes the autonomy of research decisions but rather the many links which the university is able to build with its partners in society. Virtually all our interviewees emphasised that new university laws have little direct impact on research but that the new boundary conditions indeed influence deeply innovation processes – although indirectly.

The influence of multiple negotiated partnerships

Across the ten countries under scrutiny, the autonomy of research is shaped by a proliferation of "dependencies" from different sources of funding, from the regulations they impose and from the research partnerships they request.

Figure 1 tried to outline the multifaceted and complex procedures which shape an institutional profile in the domain of research. The degree of **autonomy as far as**

research and innovation are concerned is thus always subject to negotiations and depends on the potential of the partnerships that a university manages to create. Autonomy is more and more the result of a web of negotiations involving partners of different weights, people and organs from different contexts, both in the university and within the society at large. From that viewpoint, institutions increasingly need strategies that can help them decide which relations are worth investing in, and how fruitful these linkages should be.

This requires new flexibility in university decision-making, i.e., fast procedures to take up new opportunities; at the same time, this implies streamlined internal structures that ensure the development of institutional coherence. In other terms, much more **coordination and exchange** is needed, not only with partner institutions outside the university but also with work units of **the university within.** The build up of institutional coherence is closely linked to the ability of presenting a clear profile to the outside while, at the same time, protecting institutional interests – such as the freedom of research. As a consequence, it is no longer sufficient to stick to science policies made by outside actors; institutions also need to develop a science policy of their own in order to position the university as a local entity in a global web of similar institutions. The fact that many universities start to take a closer look at PR work is symptomatic not so much of the need to "sell science" as of the obligation of internal cross-fertilisation and mutual learning in order to achieve a coherent profile. The increasingly heterogeneous landscape in which research takes place makes it more difficult, however, for policy-makers to impose external objectives on the research system as a whole. In that sense, the complexity of a research autonomy negotiated at multiple levels cannot be mastered

without a finely tuned understanding of those institutional policies that can express new strategies for university development.

The paymasters' role: the many policies for academic science

Most financial resources for the research done in universities come from outside the institution. As most of the interviewees emphasised, this is the reason why research is *not* a central issue in the debate on university autonomy and why the new university laws rarely touch this domain in extensive manner. However, when investigating research autonomy, we observed that its funding environment – to which the university belongs – its structure and the variety of its financial procedures influence, indirectly perhaps, the institution's active positioning in its social and intellectual milieu.

Firstly, the relation between regional, national and European funding has to be addressed. This link differs widely in our ten cases. In most cases, however, without any direct interference, the thematic policy of the 6th EU Framework programme (and, before it, the 5th Framework programme) had and still has a serious impact on the ways priorities are being set in national contexts. Virtually all countries – when asked for national priorities – now focus on biotechnology, information and communication technologies or nanotechnologies (and this list of areas of common areas of interest could be continued). In that sense, there seems to be a tacit consensus on where major investments should flow; with regard to these identified research domains, one could postulate that the idea of subsidiarity has regressed to the backstage. All the more so as the European Commission, even implicitly, hopes for complementary national funding to bring to completion the programmes receiving European

support. Critics stress that this streamlining tendency of research development over-emphasises the importance of certain areas, thus reducing potentially the sustainability of the knowledge system as a whole.

At the same time in many countries European money is seen as a key resource for the development of research – also within universities. In particular, for those countries with weaker economies (this was often mentioned in Hungary) or those situated at the "research periphery" (Greece is a good example that could be repeated in several countries not under investigation here), integration in European networks plays a central role in the development of their research capacity.

Secondly, one would have to address – at least for some countries – the relation between regional and national funding. Sometimes they follow different logics or different time scales and, often, different quality assessment procedures, thus causing unnecessary frictions. As a result, universities become the arena for power struggles. The same kind of frictions appears when personnel from different research structures with different working logics are located in the same laboratory, as is the case with CNRS staff in French universities.

A third perspective concerns industrial partners in university research. Some such co-operations have grown extremely fruitful and single universities now try to stress their "industrial" profile by taking special policy measures. In many countries, national policies are also developed in order to improve these collaborations. However, over time, some drawbacks become clearly visible as far as the working climate and the value systems sustaining the production of scientific knowledge are concerned.

A fourth concern is "academic capitalism". Under this term, we find a growing number of activities within institutions of higher education (sometimes intense) that

aim at attracting external income by getting involved in market activities (patents, licences, spin-off firms). Yet, as researchers stressed in our interviews, little is known of the impact such a policy, directly or indirectly, has on the way science develops and how it affects research autonomy in day-to-day routines.

Finally, we saw the importance of the balance to be struck between the resources needed for bottom-up research (curiosity driven mainly) and those required for more programme-oriented approaches (that are usually problem-based). In fact, there is ample evidence that bottom-up funding contributes to a widening of the scientific approach – thus reducing the risk of intellectual sterility in the long term. Furthermore, as the production of scientific knowledge by projects becomes ever more important, the university as an institution is challenged to create its own niches of excellence, where innovative research (which is not necessarily in the mainstream) can take place. As a result, to develop a specific profile of excellence, the institution needs to set up a science policy of its own.

The blurring frontiers: the positioning of universities in the spectrum of research institutions

Universities are confronted to a **de-differentiation** process among institutions of research and teaching. In the 19th and the first half of the 20th century, the usual organisational pattern was that of "research-sharing": some scientific institutions did basic research, others focused on problems of application, while others still centred on technological development. The consensus was that universities had basic research as a central task – an idea still deeply rooted in the self-understanding of the university: indeed, much of the debate about university reform actu-

ally revolves around this issue. Over the last decades, however, these accepted boundaries have tended to disappear or, at least, to lose their clear-cut evidence.

As a consequence, universities today have to position themselves simultaneously at various levels of activities and, in the research domain, to get ready to compete with a group of varied other institutions. This leads to institutional *de-differentiation*, i.e., a growing heterogeneity resulting in a set of divergences so important that the notion of universities itself can be questioned. Thus, in certain institutions, the working profiles start to differ so much that the risk of fragmentation develops – with a consequential loss of internal coherence that makes the public presence of the university and the related PR work particularly difficult to express.

Counter-movements: Centralisation and de-centralisation

As for the organisation of research and the decisions about the kind of research to be carried out, universities find themselves in a rather paradoxical situation. On one hand, institutional autonomy stimulates centralised decision-making within individual universities: the formal power to sign contracts has moved generally to the highest level of the university hierarchy; so has the responsibility for any major problem resulting from the contracts. On the other hand, for most interviewees, the day-to-day reality looks quite different. Project ideas come from the shop floor and the main task of university management consists in pooling these ideas to turn them into a coherent cluster of competence. To follow Etzkowitz and others (2000), one can argue that central stimuli for entrepreneurial activities become decentralised in fact, once they have become accepted by the university community as a whole.

The teaching basis for research: decoupling and new dependencies

Universities are increasingly financed on the basis of negotiated global contracts passed for a given period of time. In many cases, considering the traditional link between research and teaching, such funding is strongly coupled with the number of students taking courses at the university (or completing their degrees there) rather than with research performances, past and future. Even when research is considered in the allocation of funds, it usually plays a minor role. This reflects the strong belief that research is project-based and should be financed accordingly. At the same time, university teaching activities very much define the personnel available as the intellectual nucleus for investigation activities. In that sense, the market orientation that grows in terms of curricula offered – with the implied dependency of the institution on income generated through tuition fees – while taking into account state priorities in education, also induces increasing tensions in human resources management: Should people be selected mainly for their research records – teaching being considered a fringe activity – or are the teaching qualifications the most important criteria for hiring academic staff? Balancing the allocation of financial means between research and/or teaching thus becomes a central management issue defining the identity of the university.

This issue of research *vs.* teaching is also affected by the potential of information and communication technologies used in teaching, at least when offering some basic courses. This questions the unity of research and teaching whose links are to be understood in a completely new way, for instance by considering that the unity between the two key functions of the university is now rep-

resented at the level of the institution as a whole rather than at individual level – a model already applied in some universities, in the Netherlands for instance.

The property of knowledge

The question of intellectual property has now become a central issue for autonomous universities. Who holds the intellectual property rights? Who considers the knowledge produced in its links with potential users? What does it mean in terms of social responsibility, not to speak of legal liability: are they the researcher's or the institution's? What status does the ownership of patents give to the individual researcher and/or to the institution? These are but a few of the questions addressed in many of the countries we investigated. If IPR regulations refer to a vision of the problem shared by many countries that develop a similar discourse about intellectual property, the concrete solutions adopted here or there are very different when it comes to national prescription in this domain. While in some countries patent rights remain with the researchers (as a kind of incentive), in others the institution is given ownership of IPR; then, the university negotiates with the researchers some kind of financial compensation; in other cases, there are clear rules about how the income from patents is to be shared between the institution and the individual research workers.

The same heterogeneity can be found in *knowledge transfer* activities. In that area, options range from offices that are located in each institution to buffer bodies at regional or national level, not to speak of countries where no intermediate institution has been founded so far. Also the timing and the space given to this topic in the overall autonomy debate reveals rather nicely the actors' hidden agendas. So far, however, a number of indicators show

that the idea of universities generating an important part of their income through such activities has not turned into reality.

In the near future, one can expect a major effort to go into rethinking the interfaces between people and institutions, thus stimulating a revision of IPR regulations. Only a few models will probably emerge, one of them being that single universities will be allowed to handle property rights.

What would require further exploration – a matter not really touched in our material is the impact of patenting on basic research. While some analysts argue that patenting is the only possibility to keep research going and make it attractive in certain domains, others underline that, due to the "patent density" of certain research fields, their attractiveness becomes a reductive criterion when deciding whether to engage in specific investigation areas.

The quality of academic research: criteria, procedures and actors

The evaluation of research within universities points to the ambivalence between the ideal of a devotion to basic research and the reality of those market forces that also shape the institution. Depending on the emphasis chosen, quality will change meaning within each institutional setting. How has the definition of quality procedures and criteria evolved over recent years? How have the acquisition of financial resources, intellectual property rights, industry collaborations, or the participation in increasingly bigger European research networks contributed to transform the internal quality criteria prevailing in academic institutions? Who are the "gatekeepers" defining such criteria for quality (and are not external partners playing a growing role in this context)? In other words, what freedom has the university to set its own standards

and are these standards going to be accepted by outside policy-makers?

In our sample, the answers to these questions differ widely: huge differences exist between those countries where evaluations represent a long standing tradition and those for which assessment is a new thing, recently introduced or about to be. This clearly indicates that such procedures need time to become part of institutional culture. Cultural differences are also gaining larger visibility in this area.

Thus, even those countries with a longer tradition handle the issue rather differently – the UK and the Netherlands for instance. This points to the importance of national political culture, also in the domain of research policy. Then, the issue should not be dealt with in formal terms but rather in function of the time and energy invested by institutions to understand their own political culture – internal and external – i.e. the implicit context in which they develop evaluation mechanisms both relevant and influential. Success does not depend so much from the sophistication of formal procedures as from the integration of the evaluation culture into basic institutional routines.

Finally, we should look at what is being evaluated. We have seen that some countries still stress evaluation as a procedure assessing the input rather than the output of research work. With the shift from input- to process- and then to output-oriented evaluation, there is a growing risk of intrusion into the universities' core activities. While university researchers have long managed to position their research within given boundaries in order to attract funds, they have more difficulties to do so when the outcome of their work is at the core of assessment. This represents an important arena where the institution's

autonomy is being negotiated and where some convincing about work excellence has to be done.

The costs of flexibility: institutional interest and individual careers

For institutions, an emerging policy focus is the tension between individual research freedom and the flexibility allowing the institution to act as a collective, i.e., as an autonomous partner faced by growing competition on the "research market". Can these two approaches be combined?

In this study, we have not investigated the role of human resources and, in particular, of junior researchers, although they play a crucial role in research and innovation: their status is a test at university level of research autonomy under the new conditions. However, in our interviews as well as in part of the literature, this issue has been often mentioned – so much so that the topic will be explored fully in a follow up study. In many countries under scrutiny, for instance, the working contracts for junior researchers have been shortened to the limits of precariousness, forcing them often to integrate existing structures of investigation, at the risk of downplaying their own creativity and originality of ideas. In order to answer the needs of flexibility and mobility expected to ensure better scientific output, whole generations of young researchers are in fact required to take the risk of temporary positions, taken one after the other, at least for a large part of their early career. If indeed mobility generates new incentives and innovations, there is also a strong need for sufficient stability to prevail in order to nurture new ideas, integrate a research field and become a full-fledged researcher. In certain areas, universities are encountering difficulties to find good young researchers already now, as the working conditions in industry labora-

tories are usually more attractive. In other terms, universities will need to become more conscious of the quality of their offer to young researchers, an offer that should foster both mobility and the learning coming from accumulated experience – as well as from fresh ideas questioning the system. European fellowship programmes and also a number of national incentives are already trying to meet this challenge. Some countries have also tried to counteract these unfortunate developments (Germany creating a new position of "Junior professor", for instance), but it remains to be seen if this can lead to the expected results.

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University Research and the Stakeholders
The Expectations and Support of Government

On. Lucio Stanca
Minister of Innovation and Technologies, Rome

Mr. President, Ladies and Gentlemen,

Because of the importance of the topic of this conference, I am pleased to be here – as I am also happy to be back in Bologna, a splendid city. As I am not in charge of education, university and research in the Italian government, I will offer my personal views on the subject of university autonomy and research while also referring to the government's commitments to academia.

A modern university, for me, can be defined by three essential features. *Autonomy* is the first, the basis for everything. It does not mean a state of liberty free from any restrictions or constraints, some kind of autarchy: no, autonomy indicates action within a framework based on explicit restrictions, be they financial or legal. The second characteristic, in my opinion, consists in *openness* – a requirement made clear by Prof. Müller when he presented the case of research commissioned by large industry –, a matter I well appreciate considering my previous involvement in a big international company, IBM. But is

academia ready for that challenge? Not all universities, indeed, do welcome the development of strong co-operative links with external players – not only with business but also with local institutions and other research organisations, nationally or internationally. For many, openness represents a major challenge. The third specificity of a modern university is its *competitiveness*, in fact a result of its autonomous and open character.

May I refer to my personal experience as a Board member of the Bocconi University in Milan? One of its major strategic goals is to become a major player – at least at European level: this implies becoming much more international. If Bocconi is a well known name in Italian circles, it does not rank among the best schools of business when you go around Europe. To achieve the expected level of excellence of a strong European actor in the field, the Board is then willing to compete with other important players, for instance in its ability to attract prestigious European professors and highly talented international students – a strategy concomitant with that of openness mentioned earlier. The Board has thus to ask: why should these people come to Bocconi rather than join another institution with European ambitions? To use its advantages, Bocconi must also understand its competitors and choose with which partner – especially in business – it would like to cooperate. Co-operation is in fact a part of competition, in particular when aiming at international recognition.

In their modernisation, universities are not all betting on autonomy, openness and competitiveness and there is still room for everybody in academia to accept such strategic objectives.

But, modernisation, what for? In Italy, like in several other countries, the *capacity for innovation* is the key to the future. Finally this theme is becoming predominant. In-

deed, innovation is now a top priority on the national agenda and also on the European one, where it has been placed high by the Italian Presidency of the Union. When I say "finally", I am speaking of the Italian situation where we have delayed structural change in comparison with our main partners, in Europe or in the world at large. The system, and not the government, past or present, is at fault. i.e., we are all carrying part of the responsibility for some kind of self-complacency. Today, however, consensus exists that an advanced community must leverage innovation; there is no other choice for long-term survival. And it means acquiring the tools for competition, not only with China – a fact much debated today in Italy – but also with many partner countries in Europe. Nobody wants to go back to a closed world but, to be a strong partner of China, we must take advantage of our comparative advantages – innovation, in particular. The challenge of innovation is no simple matter and, from a political point of view, our most important political objective is to establish a *strong management of the innovation system*.

When I talk about innovation, I refer to a complex system that needs improvement – or implementation, should it not exist yet. Improvement means management, i.e., exploiting new ideas and nurturing change, a major challenge in Italy and in several other countries of the European Union. A system, as you know, is made up of many components linked by a dense web of relationships. Innovation complexity – and its steering – focuses on the interplay of three major elements, however, *knowledge*, *research*, e.g. the process of generating innovation, technological innovation in particular, as well as innovation *dissemination* in a technology pervasive society. In the strengthening of all three, academia plays a fundamental role: universities, indeed, are the modern factories of

ideas in today's communities aspiring to a knowledge society.

When it comes to *knowledge*, which needs special conditions to flourish, our major competitive factors have both an economic and social dimension: thus, quality of life is dictated by a series of managerial choices about where knowledge is being produced, where innovation is being manufactured so that the country benefits from the best system with the most effective use of scarce intellectual resources – i.e., the brains fed and developed by the institutions of education, the universities in particular. As a result, we have to invest more to make up for a structural deficit. At least in Italy, we have not been investing enough in education over the last several years. To modernise the system, we have to improve its efficiency not to speak of its effectiveness: in terms of *efficiency*, how can we justify the high drop out rate in Italian universities? what wastage, indeed, does represent the high number of students that abandon studies before completion? And what a loss of potential – if knowledge is the major factor of our future prosperity – considering that our country has one of the highest drop out rates in Europe! In terms of *effectiveness*, modernity also means that the system does not only provide the best possible knowledge – its major task – but that it prepares the students to enter the world of labour once they have their degree. To achieve such an integration, the education system must cultivate links and cooperation with external partners – in business and industry, for instance. The level of cooperation results from the strength of institutional autonomy but an autonomy grounded in the universities' action in the community, local or regional, a commitment which parallels that of business and industry. This proximity of conditions should encourage mutual learning so that student training offers an introduction to working life, on one side, and

workers' activities encourage industry's access to academic innovation, on the other. As for the long debated question of the quality and use of integrated action, supposed to diminish mind independence, I feel that the more open and strong you are, the more autonomous you can act, the better you can collaborate, thus providing knowledge with a high quality added value.

The second component of an innovation management system is *research*. There too, it is not just question of money. Of course we have to invest much more, especially in Italy where around 1% of the GNP only is dedicated to investigation, a threshold rarely passed over the last ten years. Our goal is to reach 3% by the end of this decade, a common European objective decided in Lisbon. This will not be easy and will induce a lot if changes in the research system as a whole. The first objective, indeed, is not to spend more but to get much more out of research. Thus, to modernize the research system, we need – in Italy – to introduce processes already applied in most other western countries, like project assessment policies. Money, all the more so if it is increased, should go to centres and individuals who can demonstrate their ability to reach expected results. Funds are not there to be sprinkled around in order to make everybody happy! Validation, again, is not simply a financial issue; it touches a host of other aspects – social and cultural – that give great complexity to the process. For instance, in a country like Italy with a high level of small and medium size enterprises, what should be the links between public and private investigation so that the system becomes most beneficial to society? We heard already about the complexity of the links bringing together universities and large corporations. But how much more complex and difficult it is when academia is supposed to meet the needs for innovation of myriads of SME's spread all over the

territory? It is a different type of innovation management which is required, using different tools, as the inhibition factors are more widely disseminated, more fragmented, more difficult; this leads to redesigning the field of research – while not endangering the basic investigation of ideas, one of the most important responsibilities of academia. This should not prevent from stressing also the links between research and technological innovation and, last but not least, between development and technological transfer. In terms of strategy management, what are the instruments, mechanisms and policies allowing for the best transfer of knowledge from research centres which, in this country, are mostly public to the labs and workshops of private firms? Who are the players, how to build a system, where to locate its nodes? It cannot be in Rome but must be all over the country, in environments that bring together academia and business, as well as local authorities and regional organizations not to speak of financial bodies; in their own ways, they are all actors contributing to the most effective transfer of the result of research onto the market.

And finally, a third component of the system of innovation management – once new technology is available, whether developed in the country or not – is the *dissemination* of new ideas and processes to where they can be used best: you may have the most innovative product but, should you suffer from the most inefficient dissemination processes, you will never sell it and reap the benefit of innovation ! To use better the leverage of new ideas and technology, reform is needed not only of government processes and public administration but also of business, large and small.

This is yet another challenge induced by our society's dependence on innovation! And, here again, academia should play a key role. Indeed, in my opinion, there is no

reason for business to work with academia just for *product* innovation when it can also collaborate on innovation *processes*; this is particularly true when one remembers that developed economies are more and more service-oriented, i.e., that process innovation is taking precedence over product innovation. In process innovation, indeed, there is an area of commonality for business and academia to position themselves on the frontier of knowledge development.

Personally – but this is also the view of the Italian government – I think that innovation is the key for our future and that it will affect the three major dimensions of the national system I mentioned, knowledge, research and applied technology.

I would like to conclude on one final thought about the European scale of the problems: it will be difficult to meet our innovation ambitions even if each of the present members of the Union does its best – considering that the EU will soon increase to 28 members. The new partner countries are very diverse, so that fragmentation will increase, at least in a first stage. So the challenge we have is not only to do our homework but to launch a European initiative, wide and strong, if this continent is to live up to its hopes for a knowledge society in which should converge its many components, players and relations. If innovation also means a management system involving all actors, including the universities, then much more will have to be done at the European level in order to build a strong Europe for the future.

Thank you.

University Research and the Stakeholders
The Expectations and Support of Private Funders

Dr. Corrado Passera
CEO Banca Intesa, Milan

Mr President,

Thank you, and the organisers, for allocating some time in this meeting to the banking system as a partner of the universities, and thank you for having requested my presence to offer some thoughts to the Rectors of some of the most prestigious universities in the world. My opinions are not those of a specialist of universities and research matters. But I believe I can propose for your attention a few reflections, which have matured during my experience at the head of companies which have based their actions for renewal and for growth on innovation. I would also like to tell you what we, in *Banca Intesa,* the largest Italian bank, are doing in order to collaborate in the improvement of the chain "Higher education – Research – Technological transfer", which is at the centre of the debate. These will not be technical observations but hopefully will contribute to the discussion; I will speak, in fact, of our *expectations* and our possible *contributions*.

Our expectations

In the current situation, all countries are urgently considering the subject of the recovery of their economic growth, which, for some years now – especially in the most developed countries – has been slowing down or stagnating. Every country has its own characteristics, but it is certain that wider and increasingly cut-throat competition cannot be faced and won by playing prevalently on factors such as the reduction of the cost of labour, the squeezing of the welfare systems, the introduction of protectionist policies or the increase of subsidies. This competition can be won – to the general advantage of everyone – only with a strong dose of innovation. Innovation comes from research, which has, in its turn, its place of election in the education system and big companies.

The relationship between the level of education and the wealth of a country is by now considered to be an intuitive truth. The link is certain, with structural results that emerge in the medium and long term; for this reason the relationship between the entrepreneurial system and the education and training system should certainly be studied more deeply, but it is well to avoid the planned-economy short cuts which would wish to bind the fate of research exclusively to that of the productive world.

There is no doubt that the university system represents an inseparable lever for the recovery of growth, and there is no doubt that it should be provided with greater public resources. It is also clear that these are necessary to give more autonomy from external conditioning. The first error to avoid is that of giving in to the squeeze on investments in universities and research, as if this were a "fate" that has to be accepted.

Such forms of fatalism are all the more mistaken and contradictory if we consider, for example, that the de-

mocratic model of the Italian university, with all its limits and defects, has led to an increase of 70%, in 30 years, of the number of Italians enjoying higher education. Even so, there is a need to notably increase higher education in Italy, especially in comparison with other countries of the OECD.

If we therefore wish to make Italy grow and maintain its competitiveness, it is necessary that everyone makes a strong commitment towards the university system; the method chosen by the *Observatory*, which has presented a comparison of all points of view in order to find the best solutions, is greatly to be welcomed.

To one like myself, who looks at it from the outside, the Italian university system appears as a mixture of research and education, of excellence and of backwardness, a system which is insufficiently capable of capturing and developing the value of the human capital of the country; a system which does not provide sufficient information about itself and which – also for this reason – does not enjoy the just consideration of many stakeholders, especially those in the lower social groups. I am thinking of the families which are lacking the knowledge or the experience of what the university system actually is, and yet are compelled to make a choice or to renounce, always on the basis of insufficient information. It is enough to consider that 85% of Italian families do not have either a certificate of secondary education or a degree. The university system should therefore provide itself with modern instruments, keep its links with its students and help them with the difficult task of entering into the working world better.

The banking system, which is the economic operator most interrelated with all the social players and which is most sensitive to the overall evolution of the system, *expects much* from the university system:

– greater efficiency (a reduction of the time spent in the study cycle, better orientation, increased international exchanges, more *placement* services);
– a contribution towards the competitiveness of the country through the *development of the value of the human capital* in greater quantity and with higher quality; this is the only way to avoid burning up the competitive advantage of the Italian model and, on the contrary, offering it new fuel. It's clear that in the twentieth century this fuel is called Knowledge.

And, "in exchange for this", what can the banking system offer?

Our contribution

The intervention of the banking system cannot follow the old models of liberality; these roles must remain with Foundations or public administration. The banking system must concentrate on other things. For instance:

– with regard to research and technological transfer, it must be capable of grasping the most promising signals from the universities, assisting the birth of entrepreneurial spin-offs of high technological content;
– it can commit itself to assisting the defence of innovation through patenting, both in the university laboratories themselves and in the successive use by companies;
– it can participate in projects of internationalisation between universities (mobility of personnel, research and development projects coordinated in several countries);
– it can help the universities to perform better their role of collaboration with SMEs (initiatives of technological innovation at the service of productive ar-

eas) and with the public administrations (in infrastructural system projects);
– it can assist the structural strengthening of the universities, both under the profile of research (laboratories, equipment) and under the one of student housing (the campuses).

In other words, also in this sector the banking system must *give credit to initiatives that deserve it*. In pursuing this objective, however – above all with regard to research-, it faces the problem of distinguishing the good from the not so good, the competitive from the uncompetitive, the new from the *déja vu*. All this, furthermore, in matters such as research that are extremely sophisticated, characterised by furious accelerations and sudden changes of direction, subject to competition on a planetary scale, where large structures and companies compete with still smaller and smaller realities.

It is precisely here that the bank expects to be helped by all the other stakeholders: the universities, the entrepreneurs and the companies, in order to understand the risks and opportunities of innovation. *Banca Intesa* is demonstrating today that it wishes to be present where the evaluation of the innovation and the technological transfer is shared by all the stakeholders, as in the case of the *Fondazione Politecnico di Milano*, of which *Banca Intesa* is a founder member together with large companies, administrations, category associations and universities.

Also at the other end of the chain, among the students, *Banca Intesa* wishes to help the university system to improve its capacity for input/output of human capital. Here, pilot schemes are necessary, such as our *IntesaBridge*, the first ever system of student loans introduced in Italy, in cooperation with the three Polytechnics of Milan, Turin and Bari.

We have been working on this since the beginning of 2003, with the intention of making it available to students at the beginning of the current academic year.

I wished the bank to measure up to one of the most backward factors of our system, the total absence of student loans which some consider a typically Italian characteristic, finding the cause in the low university fees and the *defensive family umbrella*, which discourages students from "thinking as adults", assuming – among other adult responsibilities, also the one of getting themselves into debt. As a consequence, in our country 3 million new students – the number which has passed through the university system since the law on "loans of honour" was approved – have remained substantially deprived of the instrument for the financing of studies which is normally used by their peers in other parts of the world.

This has resulted in a loss to the Italian productive system and in the frustration of many young people and their families, for the most part belonging to the less wealthy social classes. It is probable that this lack has contributed to the poor social mobility which characterises our country.

In reality there exist also in Italy the conditions for introducing modern student loans, that is to say:

– given directly to the student, without any guarantee offered by his/her parents;

– linked to the progress of his/her studies, understood not only in the sense of excellent marks but also respecting yearly timetables established by the university;

– of sufficient quantity to be an effective help towards his/her studies;

– repayable over a long period of amortisation, after a *period of grace* of one year to allow him/her to find a job.

And this is the formula for the loan which we have prepared.

If we consider that in July/August, 180 requests for loans have been received out of an eligible population of 10,000 students at the Polytechnics, compared with 148 loans granted in the whole of Italy in 2003 (out of a population of 1,700,000 students), it appears clearly that the supply of good services is able to stimulate strong demand.

Among the players at the base of this success, the *Fondazione Cariplo* has been important. Because it contributed to the constitution of the guarantee fund. In this operation it has played the role that should be the one of the public administration. Also the European Investment Bank (BEI), which has supplied the capital to be used in the project, has inaugurated for this operation (so small in its dimensions) a new segment of intervention intended to facilitate higher education. It is precisely this "extraordinary" work carried out by major organisations (the European Investment Bank, the *Fondazione Cariplo*) which makes me optimistic. This shows a common faith on the part of some of the major economic players in higher education as a motor of a society which is more mobile, more just and *therefore* more competitive.

This university loan, that we call "Bridge", is not intended to substitute all the other instruments statutorily available for the facilitation of our young people's higher education. It is "enough" for us to innovate the schemes: no longer merely the free intervention on behalf of the "deserving poor" (such as a scholarship), whom the Constitution identifies as the natural beneficiaries of the right to study, but also modern credit instruments, similar to those available to entrepreneurs.

It is not only a fact of justice: the students of the best Italian universities deserve credit as the "entrepreneurs" of higher education.

In the realisation of this initiative we have experimented the practicability of a model of "trust cooperation" in which the Bank has been able to sustain a project with credit, by using innovative criteria: the credibility of a life project judged on the basis of indications offered by the university where that life project is carried out.

The education of an individual through our "Bridge" loan or the industrial spin-off arranged through the cooperation with the *Fondazione Politecnico* are entrepreneurial projects. To evaluate their success we must collaborate with all actors able to give new evaluation instruments.

In many cases we talk about a dialogue with new partners or about a different way to dialogue with a traditional partner. Anyway this implies a large cultural change: the bank is ready to face it.

University Research and the Stakeholders
The Expectations and Support of Private Industry

Prof. Klaus Müller
Head of Science & Technology Relations, Hoffmann-La Roche, Basel

Excellent co-operations between industry and academia have been essential in the past, they are essential today, and will continue to be so in the future. This is particularly true for a modern research-based pharmaceutical company like *Roche*, whose success relies on qualified research efforts that are substantially above the pharmaceutical industrial average worldwide.

Roche attracts brilliant scientists from all disciplines, fosters their imagination and creativity in a mutually stimulating research atmosphere, and promotes their efficiency and productivity by constantly developing its innovative expert technology platforms. There is a constant need for highly qualified scientists capable to cope with the enormous challenges of modern pharmaceutical research. Hence an excellent in-depth and broad education of young talents at the forefront of science is a prime request of pharmaceutical industry to academia. Teaching of accumulated knowledge up to the highest levels must be complemented by building strong theoretical and practical competence as well as fostering scientific acumen.

Apart from well structured curricula of courses and practical work, the best education of developing scientists is by their continued active participation in first-rate research, e.g., pharmaceutical research projects with their inherent scientific breadth and links to neighboring disciplines. The exposure to new research opportunities as well as the awareness of important unsolved problems and promising progress are important factors that stimulate scientific curiosity, a desire to engage in frontier research or technology developments, and foster interdisciplinary flexibility.

Scientific excellence must be complemented by technological expertise. There is a mutual interdependence between research and technologies, as research at the cutting-edge not only requires state-of-the-art technologies, but often pushes existing technologies to their limits and beyond, thus continuously fostering technological innovation. While many new technologies emerge as natural spin-offs of basic or applied research, the target-directed development of novel technologies should be guided by real unmet needs; this is best possible in settings that enable regular and close interactions between technology experts and their potential research customers. Novel technologies may provide more accurate, more insightful, more decision-relevant data more quickly, or may provide entirely new approaches to hitherto unsolved problems. Over many decades *Roche* has built successfully on this duality of research and technologies, having been the first or among the first pharmaceutical companies to develop, implement, and use many of nowadays well recognized key technologies in frontier pharmaceutical research.

Successful management of the interface between research and technologies is a considerable and continuous challenge. It requires people of the highest scientific and

technological caliber with the ability to create and share visions, to foster and sustain a spirit of entrepreneurial cooperation between different camps of research, technology, and engineering, with an in-depth understanding of the processes in both research and technology development, and a capacity to shield exploratory activities from the occasional impatience of senior management. Research and technology experts must be willing to collaborate closely. The technology experts must sense the limits of current technologies in real applications and be sensitized to future needs or opportunities for innovations. They must respond through fast prototyping to address the key issues of envisaged applications, followed by assessments made jointly with the research scientists so that further developments remain closely guided by the research reality and its application needs. Together, creative scientists and technology experts can best envision novel analytical concepts or scientific methodologies that may foster innovative research altogether.

Clearly, the interdependence of frontier research and modern technologies holds equally true for academia. It is sometimes frustrating to witness an almost total neglect of this truism in public funding policies which are often too much biased on innovative research without recognizing its intrinsic need to keep up with and even participate in ever faster technology developments in all areas of the Life Sciences. It must be emphasized that a well balanced science and technology base is crucial for an adequate education of the young generation. The most important phase of scientific education, i.e., the learning through active participation in frontier research, is seriously jeopardized if an adequate modern technology base is not available. Academic institutions that are not enabled to keep up with modern technologies are doomed

to slip into second and third tier and may eventually disappear from the focus of industrial interest.

No single institution, whether academic or industrial, can embrace all scientific and technological activities relevant in pharmaceutical R&D. Therefore, cooperation and collaborations between complementary partners are essential. For *Roche*, these may take place in a large variety of modalities ranging all the way from strategic alliances to informal contacts, from fully shared participation models to one-way fee-for-service or licensing-in arrangements, from an entirely open cooperation to collaborations under strict exclusivity; and it goes without saying that the external partners may be either academic or industrial. The same could or should be true for academic groups. The enormous potential of forming scientific networks and technological platforms for research groups across departmental, institutional, and national boundaries, including industrial partners, begins only to be recognized in many European countries. Unfortunately many top-down initiatives, with all their best intentions and massive financial investments, have not yet produced the expected synergies, partly because such initiatives have been too much politically driven, ignoring the real dynamics and intrinsic needs of individual research groups, partly also because many research groups or institutions are not yet ready to engage in new ways of shared research and technology development.

The initiation of potential collaborations between academic and industrial groups is sometimes thwarted by mutually shared misconceptions of a putative schism between basic and applied research, the former being identified with academia and, while admired, often not regarded as sufficiently relevant by industrial groups, the latter being associated with industry and often disregarded as intellectually less rewarding, albeit necessary.

On the one hand, many academic groups still fear a contamination of basic research principles and loss of academic autonomy when considering collaborations with industrial partners, and entrepreneurial groups engaging in such activities are sometimes under pressure by their academic peers who tend to disrespect research undertaken in cooperation with industry. On the other hand, industrial groups are often too preoccupied with issues of intellectual property, behave in an overly secretive fashion, and often regard academic research as not being sufficiently focused or target-committed.

Of course, in the vast majority of cases, and particularly in the Life Sciences, neither is true. For both academia and industry, research activities typically navigate in a dynamic fashion in the interface between basic and applied research. There is no applied research without solving fundamental problems when and wherever they arise. Likewise, basic research, if successful, not only results in better understanding of basic aspects, but also and most often opens windows to many intellectually most rewarding novel practical avenues. Hence, neither do the academic groups remain in splendid isolation in their 'purely basic' research nor do the industrial groups hesitate to address fundamental questions when these are relevant to progress in a purpose-driven project. Thus, the difference between academic and industrial research is not so much given by the relative location on the axis of basic to applied research, but rather by the primary focus on research objectives, i.e., more fundamental and general problems *versus* more specific tangible end points.

Consequently, there are many opportunities for mutually beneficial cooperation and collaborations between academic and industrial groups. Witnessing the (many) unsolved scientific problems with which (pharmaceutical) industrial research is confronted in its target-driven re-

search, academic groups can take much stimulation to address such questions on a more fundamental and general level leading to improved understanding for the benefit of all. On the other hand, novel insight gained by an academic group often stimulates a number of interesting opportunities for further scientific or technological developments that require the cooperation of an industrial partner.

Thus, industry and academia can be complementary partners who can cooperate in fruitful and mutually beneficial ways. This is particularly true for the pharmaceutical industry. The discovery of novel disease mechanisms in academia requires an industrial setting for its conversion into therapeutic innovation, and novel technologies emerging from academic groups often benefit from a confrontation with the diverse and demanding application requirements in an industrial setting. On the other hand, target-driven research programmes in industry regularly touch on important and often fundamental problems, which are then addressed in a rather pragmatic manner, but would merit more fundamental research efforts for the benefit of a better basic and more general understanding. Therefore, the complementary research foci by industrial and academic groups are not an impediment, but rather a rich source of mutual stimulation, new research, better understanding, and discoveries.

For interactions between a pharmaceutical industry and an academic group, we may differentiate two extreme modes of cooperation. The first represents a simple customer-vendor relationship in which a scientific discovery, important know-how, new technology, or relevant research activities by the academic partner is exchanged for license fees or fee-for-service payments by the company. The second is a fully integrated partnership in which both the industrial and academic partners collaborate in a joint

project, exchange their scientific know-how and technology expertise, cooperate in all required research and development activities, and even share project costs and risks. Of course, the reality lies rarely at these extremes, but may take any position in between. Thus, real collaborations between academic and industrial groups are characterised by a mix of compensation payments of various kinds, sharing of information, know-how and technology transfer, research cooperation of all sorts, exchange of results and materials, as well as temporary transfer of collaborators. There is no fixed format, and the relative importance of the various aspects depends on the specific project requirements, reflects more on the reciprocal needs of the partners involved than on company policies, and may even change dynamically as the project proceeds.

Of course, there are always certain policy elements to be observed on either side, but, in the pre-competitive area of pharmaceutical research and technology development, they should not dominate the setup of a given collaboration. However, when they do, they pose obstacles that may jeopardise the arrangement of a desired collaboration. Indeed, over more than twenty years at *Roche*, I witnessed innumerous excellent and mutually highly rewarding collaborations with academic groups. However, I have also seen a few cases where an intended cooperation could not be set up due to relatively inflexible policies in place at the academic site, much to the sorrow of the academic group that wanted to collaborate with *Roche*.

Roche is a healthcare group active in the discovery, development, and manufacture of pharmaceuticals and diagnostic systems. In these core areas, it has to defend its business interests. Accordingly, collaborations with external partners in these core areas have to follow strict rules that protect *Roche*'s interests. However, this still leaves vast areas of pre-competitive research and tech-

nology developments for collaborations with external partners, in particular with academic groups. For the latter, *Roche* strives for non-exclusive open collaborations, recognizing the need of academic groups to publish and educate through project work. In general, this presents no problems and has resulted in numerous excellent collaborations in the past and at present.

However, with the increasing expectations and pressures on academic groups either to have their start-up companies into which they transfer their discoveries or to behave themselves like small profit centers, looking for technology transfer opportunities for every small or large discovery, the room for uncomplicated collaborations has become somewhat narrower. Very often an offered 'technology' has not yet reached a development or validation stage where it could be taken at face value, but would need substantial further research or co-development. While this may be in the genuine interest of both parties, an obstacle may be posed by academic technology offices which have the task to ensure that any such cooperation brings substantial revenues to academia, independently of the interests or benefits of the academic group. The cooperation of *Roche* with an academic group may become more complicated if its associated start-up company is also involved. There are now three partners to satisfy, and the start-up company has a legitimate interest to protect its research efforts and may even be a competitor to *Roche*. This is not conducive to a lean open collaboration with the academic group, requires complicated negotiations, and may result in *Roche* declining a cooperative offer in favour of a leaner partner elsewhere.

For collaborations between *Roche* and an academic or industrial partner, there are a number of important factors that enable good partnerships and successful collaborations. First and foremost, there must be high scien-

tific and technological competence on both sides so that excellent peer-to-peer relationships can be established. There must be a good mutual understanding and acceptance of the overall project goals and intermediate milestones, with a convincing partitioning of the project into complementary parts according to the specific expertise and skill sets of the collaborating partners, a good common assessment of risk factors and critical issues, with a willingness to perform early feasibility studies, to act promptly on new findings or requirements, and to learn in a stepwise fashion, with an openness to redesign and respond to changing needs.

In collaborations with an academic group, a company has also to recognize the intrinsic differences of industrial and academic agendas. First, while a company can initiate a new project promptly, the academic group may not be able to start immediately, but have to await a next collaborator to join the group. Thus, the company may have to assist the academic group in providing advance financial commitments enabling the head of the academic group to start early looking for most suitable collaborators in the new project.

Second, while industrial research is purpose-driven, academia has a strong curiosity-driven component. This must be mutually recognized and respected. Thus, the industrial partner should not prevent the curiosity-driven activities of the academic partner; but the latter must also recognize the needs of the industrial partner to move on along the delineated development path of the project. Hence, there must be compromises on both sides; the simplest being that the academic group is free to follow-up on scientifically rewarding side-tracks in parallel to the agreed tasks – and this generally tends to be beneficial for both.

Third, for the (pharmaceutical) industry partner, research and technology activities have to be prioritized according to maximum potential impact on drug discovery, while the academic group's priority may be scientific and technological novelty that could eventually lead to important publications. Again, these legitimately different priorities have to be reconciled by proper assignment and foci of the various tasks.

Fourth, a private company has experienced experts on the project, whereas the academic group, except for its supervisor and his long-term assistants, has young collaborators either at the undergraduate, graduate, or postgraduate levels. These collaborators will and have to be educated through their project work. Clearly, this may even be a welcome benefit of the collaboration, by which young talents are exposed to interesting novel research or technology problems and get an opportunity to experience both the academic and industrial component of the project. Therefore, it is mandatory that the industrial experts recognize this aspect and take the opportunity to act as additional supervisors of their young colleagues on the academic side, rather than impatiently forcing them to speed up and fulfill impossible tasks.

Finally, and often sadly, a project may have to be terminated due to rational assessments of results and goals. This typically happens promptly in an industrial setting, but cannot be done so easily by an academic group since PhD students and, to some extent also postdoctoral fellows, need research continuity for their optimal education and training. This is not to say that the academic group should then be encouraged to continue on a non-promising project, but rather that the industrial partner must recognize a vital element of the education-through-research mission of academia, and thus should tolerate a mid-term smooth conclusion of the project

with focus on scientifically still rewarding aspects of the project, even if these will not contribute anymore to the original project plans.

Thus, we may summarize the enabling factors for rewarding collaborations between industry and academia as follows:

There must be a good mutual understanding of the needs, interests, and time lines between the industrial and the academic partner. The project should be subdivided in a process-logical fashion into complementary parts that represent interesting and challenging scientific and technological aspects for both parties. All mission-critical experiments, the set of required feasibility studies, and follow-up activities should be carefully planned in a joint effort to allow both parties to adjust their agendas to the needs of the project. There must be sufficient resources on both sides and a commitment to prompt actions upon new findings and results. There must be a good match of scientific competence and technical expertise on both sides with regular peer-to-peer interactions from the beginning until the end of the project. Information and results should be exchanged on a continuous basis, while the progress of the project needs to be assessed jointly at regular intervals at a mutually agreed project-specific frequency. Likewise, important decisions must be taken jointly and with full transparency. Exchange of materials and tools must occur promptly and without bureaucratic hurdles, and, whenever possible, collaborators in the project should be allowed to move easily between sites. Industrial placements for a limited time have proved to be a most attractive and efficient way to provide young collaborators a broad and in-depth view on important aspects of a common project. If additional research or technologies are needed to complete or complement relevant tasks of the project, this should be handled in a

most flexible way and should not become the subject of additional negotiations.

Collaborations between industrial and academic partners, if well prepared and designed in a complementary fashion, generally turn out to be mutually highly rewarding. It allows the two groups to focus on complementary aspects of a given project, the industrial partner more on key technical matters and specific application issues, the academic group on the more fundamental and general questions. The timely coupling of their activities then results in a broad and differentiated knowledge gain. There is much mutual stimulation when new insights into basic mechanisms have direct impact on applications, and more insightful applications generate new questions that spur further basic research.

Consequently, the catalogue of expectations of private industry to academia given above ought to be extended by a further point: openness to various forms of cooperation, not only across disciplines and academic institutions, but also and in particular with industrial partners, not primarily because such collaborations may be rewarded by financial support from the industrial partner or from research-political programs, but genuinely because such collaborations have significant potential to advance science and technology to the benefit of all.

The availability of academic groups must, however, not be misused by the industrial partner. Academia must never be an extended arm of private industry and must not be engaged as a 'cheap' way to solve difficult scientific or technical problems. Pharmaceutical industry must recognize both the enormous potential and precompetitive nature of research towards an improved understanding of fundamental aspects in the Life Sciences. Its collaboration with academic groups should therefore foster a focused exploration of relevant scientific ques-

tions as a contribution to its own benefit, but also to science. Through collaborations of the proper kind, the autonomy of academia is never jeopardized; on the contrary, it will be strengthened since through relevant research that promotes both basic science and innovative applications academic institutions gain visibility, which in turn augments their strength and stature. Only the best academic institutions are viable partners for industrial collaborations.

Case Study
Partners in Research: Balancing Creativity and Responsibility

Prof. Ian Leslie
University of Cambridge Computer Laboratory

Introduction

Collaboration with industry is, for some areas of university research, essential. Obvious benefits are increased resources, increased understanding of what is relevant and the opportunity to engage with a diversity of intellectual talent. There is the potential for negative consequences also, such as a loss of control of the research agenda or the tying up of intellectual property in ways which close off opportunities. I would like to examine these issues in the context of my experiences in Cambridge, particularly in relation to dealing with large corporations.

I believe that the motivations of industry are not always understood by academics (nor in some cases by industry itself) and in particular that the diversity of motives is seldom recognised. If there is a sound bite from this talk, it is that "one size does not fit all".

Context

As this is very much a case study, it is important to provide some context about my institution, my field of research and me.

The University of Cambridge is by any standards an extremely successful research institution. The current funding regime in the UK means that it has to be very focused on its research output and research ratings. Some would go so far as to say that the financial motivation for the University to be focused on its research output is in danger of distorting its overall academic mission.

The success of the University in generating wealth is well documented in the *Cambridge Phenomenon Reports* of 1985 and 1998[23]. The University has a very liberal attitude to ownership of IPR; in many cases the individual academic owns any IPR they create. (This is now under review, although it is likely that the individual academic will still have a very large say in how any IPR is exploited.)

Within the UK university sector as a whole, UK government is concerned with how universities interact with industry and society to create wealth and to improve social conditions. This concern has taken the form of a new funding stream, the so called third stream funding, distinct from teaching and research funding streams. It means that universities are re-examining their relationships with industry. Most recently, UK government has commissioned a study, the *Lambert Report*, on the interaction of universities with UK business[24].

In preliminary findings, Lambert singles out Cambridge as being successful but disorganised, although he

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[23] *The Cambridge Phenomenon* and *The Cambridge Phenomenon Revisited* Segal, Quince and Wicksteed, available via www.sqw.co.uk.
[24] See www.lambertreview.org.uk.

does not seem to entertain the hypothesis that there may be causal relationship between the two.

Focusing in on my perspective within the institution, my department, the Computer Laboratory[25] has a history of interacting with industry dating back to 1960. It is credited as a large contributer to the Cambridge Phenomenon. Its graduates have founded over 80 companies, not all in the Cambridge area, or indeed the UK.

The Computer Laboratory has a long tradition of engineering real systems, but it is now a broadly based computer science department with one of the strongest theory groups in Europe.

Focusing further, I work at the practical end of the subject (computer networks) with continuous collaborations with industry and I have been involved in two start-up companies.

Motivation

Having provided some context for my personal motivation, let me turn to the motivation and values of others. First, within academia, there are many values and motivations. While academics may share much common ground, it is important to recognise, and indeed applaud, the diversity of motivations within universities. Within my university, there are many who are excited by seeing their ideas applied in industry, while there are others who see university co-operation with industry as inherently bad.

Motivations for academics will be coloured by the area in which they work, the opportunities for transferring ideas into industry and the time scales on which re-

[25] The Computer Laboratory is the Computer Science Department of the University.

search turns into products in the particular sectors that are relevant to their subject.

Motivation in industry is also diverse, related again to time scale for research to reach market, but perhaps more importantly, related to the size of the company. I would like to focus on four sizes of company: start-ups, medium size, large and dominant.

All companies will be interested in recruitment. This is perhaps the only constant motivation. To oversimplify somewhat, start-ups will be primarily interested in a helping hand including access to special resources, medium size companies will be interested in consultancy, large companies will be interested in research which gives them some competitive advantage, and dominant companies will be interested both in increasing the size of the sector and in increasing their share of the market. Recognising these distinctions has been an important insight which shaped our strategy for interacting with industry.

Microsoft

Where did these observations come from? Let us start in the mid 1990's with the announcement that Microsoft wanted to open a second research laboratory, and that they wanted to locate it in Cambridge, adjacent to the Computer Laboratory. At this time, there was only one Microsoft research lab in Redmond near the Microsoft head office.

There was of course a sense of pride that our department had been singled out in this fashion, but there was widespread panic that "Microsoft were buying the Computer Laboratory".

The original plan was that a single new building would be built and that Microsoft would lease space within the building. A negotiation process was then be-

gun to deal with IPR. The extent to which this negotiation had to be carried on in secret is possibly still a topic of conversation; but it was, and this caused considerable pain. Nature abhors a vacuum, but rumour thrives on it. In the end, and with considerable effort on both sides, an agreement was reached that the parties would work together if joint intellectual property was created.

The spark of insight in this process was the realisation that Microsoft's interest in coming to Cambridge was not to get their hands on the intellectual property of academics, but to be part of a bigger community where ideas flew back and forth. Yes intellectual property would be created, but Microsoft would create more itself by being in such an environment. And don't forget recruitment...

This on the ground insight took some time to propagate into the higher layers of both organisations, but propagate it did.

As the building project began, it became clear that Microsoft would require more space than would be available in the single building, so another building was also started. In August 2001, the Computer Laboratory and Microsoft Research moved into their two separate buildings. This physical separation has removed most of the concerns that Microsoft might have too great an influence on the Department.

In practice, Microsoft Research Cambridge perform the vast bulk of their research independently of the Computer Laboratory, and Microsoft Cambridge sponsors research in a number of universities across Europe. Laboratory work funded by Microsoft tends to be put in the public domain. This is always true in the case of sponsored PhD students.

Marconi

In 1999, Marconi approached the University with a view to set up a research facility, again next to the Computer Laboratory, but with the intention of collaborating with a number of departments in the University. In 2000, Marconi and the University signed a Memorandum of Understanding which provided for £24 million in building and research contracts.

Marconi's focus was very much on working with the University (whereas Microsoft wanted to be part of the intellectual community). Moreover, Marconi, although large, could by no means be considered a dominant player. They wanted competitive advantage. This meant that the discussions over IPR were more complex, and despite shop-floor scientists being able to agree with the proposed principles the organisations were unable to do so before Marconi ran into severe financial difficulties. In 2002 Marconi Research Cambridge closed.

Had Marconi not had financial difficulties, I am confident we would have reached agreement, but it was a lesson in understanding diverse motivations. Of course, had we agreed prior to the financial difficulties, it would have been rather messy when the financial problems arose!

Intel

In 2002, Intel approached the University to discuss setting up a "Lablet" in Cambridge by leasing space within the Computer Lab building. Intel Lablets (there are four in the world) are associated with University computer science departments and only work on research which is to be put in the public domain[26]. Intel are very

[26] See www.cra.org.CRN/articles/nov2/mulder.html.

clear that this research activity is about increasing the size of the market rather than improving their position in it.

Lessons had been learned, and Intel's dominant position made its motives much easier to deal with. In fact, at this point in time we have no legal framework agreement with Intel (other than a lease) and currently we see no strong motivation to have one. We do have project by project agreements, which all provide for results to be released in the public domain.

Observations, Conclusions

Our experience with dominant companies confirms the view that they can actually be easier to work with, but only if there is a shared view of motivation. Large, non dominant companies are potentially more difficult to engage with, but there may still be areas in which agreement can be reached to put results in the public domain. On the other hand, universities should be open minded about carrying on research where the results will belong to the industrial sponsor.

Medium size companies are in general less interested in what universities would regard as research. Encouraging academics to engage in private consultancy is actually beneficial to the university. Most importantly, it gives academics an understanding of what problems are facing industry (and perhaps more importantly what problems are already solved). It also helps universities to be seen as involved in the wider world. This is particularly striking in a high tech cluster such as in Cambridge, where most interaction is with academics acting in their private capacity rather than as part of the University.

I would like to conclude by returning to the motives of the University. Although I have not stated this explicitly, I take it as real that Universities wish to retain control

of their research agenda. There are two aspects to this. First, they want to be in a position to choose what research to pursue; secondly, they wish to have access to the intellectual property that has been created. For universities, indeed, it is far more important to have access to intellectual property rather than to own it. In particular with the exception of pharmaceutical research, (and even there things seem to be changing) university technology transfer offices lose money. For example, one institution which you might expect to be rolling in income, like Stanford, just manages to break even!

So making money from technology should not be a university motive. Retaining control of the research agenda should be. Transferring technology and being able to list successful transfers
should also be a motive.

Retaining choice over what research to perform is about cultivating opportunity. Universities, departments, even research groups, should put effort into having a portfolio of industrial relationships, preferably with a diversity of motives.

Most importantly, they should be aware of industry's diverse motives while being aware of your diverse motives.

Young People and Research

Dr. Nora Brambilla, Milan
On behalf of the Marie-Curie Fellowship Association Delegation

Modern societies are knowledge based societies. This means that they are based on science, which produces knowledge, and on the capability to effectively turn new knowledge into technological innovation. Indeed, it has been finally and generally realised that science accounts for a great part of the economic growth of society, and hence for the creation of jobs for everyone, i.e., the creation of wealth, prosperity and a better quality of living for all of us.

Universities are among the main centres of research in our society. They have a key role in the education through research of the new generations and in the production of research. Thus, university autonomy in terms of research is a particular relevant but delicate theme.

A few remarks of importance: on one hand, the reason why university research is progressing so fast is the fact that it is basically open and free to the whole scientific community. Research results, once published, are available in full to all researchers. This phenomenon, for instance, is particularly striking in the high energy physics community where articles are currently posted on a pub-

lic accessible web archive even before being published. Another suitable example is the exponential expansion of the Linux system whose source code is open and can absorb all individual efforts.

On the other hand, a good point of modern societies is the existence of intellectual property rights that reward smart ideas and research inventions. It represents a frame of progress for productive individuals and the companies. The drawback of the system consists in the restrictions it imposes on research: data and information in some environments, industrial in particular, that are not open to all; this slows down cross-fertilisation and the pace of progress.

When we talk about public and private research we refer mainly to fundamental research and technological innovation respectively. Between these two a very delicate and important interaction exists: the science-technology spiral. Science, seen at a distance, might appear to proceed steadily and systematically, but in reality it has a complicated, motley structure. Lines of research often run in parallel, the same results are obtained almost simultaneously in different places, sometimes apparently divergent lines converge later and seemingly blind alleys may have an issue leading to new perspectives. The development of technology presents a similar pattern, often even with a more complicated structure. Technology today always draws upon earlier scientific results. However, there is always a time lag of at least ten to twenty years when it comes to relate scientific discoveries and technology. Over the last hundred years, this time lag has been remarkably constant, even if, today, it is showing a definite *tendency to increase*. Moreover, the progress of science depends on technology and science uses immediately the new technological developments without any time lag. Such processes and interactions are complicated

and cannot be planned. In other words, one cannot stick to technology only to obtain technological applications.

Furthermore, working just in fundamental science, one can get wonderful and unexpected applications, such as the *web* which was born at CERN for the communication needs of the physicists who were hunting particles in the accelerator! This implies that investments need to be made *both* in fundamental science *and* in technological applications, thus creating the conditions for a lively and fruitful scientific environment.

The autonomy of research is a most important value and should be protected by society. As a result, universities should be independent players in the field. By keeping always a component of fundamental research open and accessible to all, universities can guarantee the conditions of a steady research progress while educating and communicating to the new generations the knowledge accumulated in the many research fields of their interest. This should coexist with a sector of technological innovation covered by the intellectual property rights. The two worlds should merge as much as possible both in university and in industry and in between the two. Private capital should be used both to develop fundamental research and to support technological innovation. This is not yet the present situation in Europe (some national states are particularly far from this situation) and a big effort should be made to attain it. The *Casimir project*[27] which was started by the MCFA association in collaboration with university and industry pursues such objectives.

In this process one should not forget that a knowledge-based society chiefly focuses on people. It is of the utmost importance that universities train and prepare the "human capital", i.e., the researchers of our society, re-

[27] http://wwwteor.mi.infn.it/~brambill/casimir.html

membering that the best possible training for research is the training through research. Once such human resources have been prepared, it would be more than appropriate to use them correctly.

Instead, we hear from the concrete experiences reported here that this is not the case. The careers of young or relatively young researchers are hardly sustainable, very few opportunities and long term perspectives exist for highly trained scientists. They are not absorbed in appropriate positions in academia or in industry. Incredibly enough, such people encounter the problem in Europe of being considered aged and over-qualified once a project disclosed. Thus, they experience in their lives what the lack of exchange and interconnection between academia and industry can mean. Huge amounts of money are being invested to train young scientists and turn them into excellent researchers, but then society is not able to use them profitably by creating opportunities to use their skills to the benefit of the community at large. This represents a huge and most unfortunate economical waste. The resulting situation is having serious consequences for Europe: there is an important brain drain towards the US (mainly) where young researchers have much better career prospects. Moreover, traditional European industry is ageing and unemployment rates are increasing due to the dislocation of conventional industrial capacity to developing nations, a situation made worst by the fact that Europe lacks innovative ideas to put to work.

The building of a European society based on knowledge and on research – with universities as autonomous sites of research production – is facing many difficulties today, especially in the South and the East of the continent. There are many reasons for this, besides poor conditions of national economies in these regions: in particular, there is the lack of understanding (in governments

and also in people) of the clear benefits research and innovation can bring to society; another reason is the widespread belief that research is a very difficult task not suited for the less advanced economies. Notwithstanding the full scientific programme of the European Commission that calls for 700'000 new researchers, for better research careers and for 3% of GDP to be spent in research by 2'010 – a set of objectives endorsed by all the European national governments that publicly support the programme –, the situation for researchers has recently worsened and keeps doing so.

If we want to build and maintain a strong, fruitful and autonomous world of academic research, all efforts should be made to reach the following targets:

– Increase the expenditure in science, research and development also with resources coming from the private sector;

– Increase the number of researchers in the work force both in industry and in academia;

– Create real opportunities for researchers to put their skills at the service of society, thus not wasting human capital that have been invested in for so long, and give more space and weight to young researchers;

– Motivate industries to invest in research with a series of legal instruments;

– Coordinate this effort with the nation-states so that all seriously commit to their national development goals in science and research;

– Monitor their true commitment and support corrective action in case of bad practice;

– Coordinate and increase the scientific collaboration of nation-states to reach the necessary critical mass, thus avoiding the fragmentation of research;

– Promote scientific excellence and give a real chance to excellence;

– Publicise the way new ideas in science and technology evolve and who has benefited from this – in the past and today;

– Involve the universities in the innovation process as the hard core of the knowledge revolution.

In other words, all efforts should be made to realise concretely the vision and programme of the European Commission in science and research!