

EUROPEAN UNION RESEARCH ADVISORY BOARD

INTERDISCIPLINARITY IN RESEARCH

April 2004

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SUMMARY OF RECOMMENDATIONS

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| AVOIDING UNNECESSARY ADMINISTRATIVE BARRIERS TO INTERDISCIPLINARY RESEARCH |
| <ul style="list-style-type: none"> • Ensure that any future EU expert group / advisory board / working group systems, which are developed, do not create barriers to interdisciplinary research. Equally, in setting up internal administrative Programme Divisions and the definition of Work Programmes, care should be taken not to create barriers to interdisciplinary research. • In the development of the Thematic Priority (“Vertical”) Work Programmes 1) balance the need for highly targeted Calls for Proposals with the need for interdisciplinary research and 2) investigate the need for cross-Priority and cross-Action Line Calls for Proposals. In the “Horizontal”, less-discipline defined, Calls for Proposals, ensure that evaluation panel composition and procedures move to a “broad discipline” approach. • In working with universities, encourage the examination of discipline-based, Departmental and Faculty divisions and associated employment procedures to ensure that they are not an unnecessary barrier to interdisciplinary research and that the means and facilities for such research can be guaranteed. Interdisciplinary research expressly includes the Social Sciences and Humanities. |
| IMPROVING INTERDISCIPLINARY TRAINING |
| <ul style="list-style-type: none"> • Consider establishing, in conjunction with Member State authorities, a high level, EU Doctoral Programme in new, emerging areas, which cross discipline boundaries. Examine the NSF IGERT Programme as a model. • Review recent developments in industry-based and industry-related doctoral training. Transfer good practices to develop FP6 Programmes, including, in particular, the Marie Curie Programmes. • In working with universities, develop programmes, which encourage Departments to provide the opportunity for undergraduates to take credit modules outside their own speciality and, in their final year, to participate in multidisciplinary project teams. • In working with universities, encourage them, individually or as a local network, to develop Graduate School structures which, when required, can more easily span traditional disciplinary divisions in research training. |
| A POLICY FOR INTERDISCIPLINARY RESEARCH CENTRES |
| <ul style="list-style-type: none"> • Undertake an examination of good-practice and success factors in “virtual laboratories” and “virtual research centres” paying particular attention to their use in 1) the development of interdisciplinary research and 2) Networks of Excellence. • Before co-funding the setting up new interdisciplinary research centres, balance their costs and benefits against the funding of the reform/extension of existing traditional disciplinary structures. • In co-funding a new interdisciplinary research centre in a university, ensure that the centre has made provision for its integration with the teaching and research activities of the traditional disciplinary Departments. |
| DEVELOPING SHARED RESEARCH FACILITIES |
| <ul style="list-style-type: none"> • When co-funding major research infrastructure and facilities, ensure structures and procedures are in place to permit the appropriate, intra-and inter-institutional access to such facilities. When appropriate, such core facilities should be encouraged to develop interdisciplinary training provision. • Examine the possibility of extending the practices (particularly interdisciplinarity activities) developed in “Access to Research Infrastructures” to appropriate Thematic Priorities for use in Integrated Projects and Networks of Excellence. |
| FUNDING AND MANAGING INTERDISCIPLINARY RESEARCH |
| <ul style="list-style-type: none"> • Ensure robust and transparent mechanisms are in place for reviewing both 1) the interdisciplinary elements of discipline focused proposals and 2) fully interdisciplinary proposals. This may include flexibility in the allocation of projects to discipline-based panels with cross-referencing and joint evaluation. • Ensure that the structuring of work programme budgets does not discriminate against interdisciplinary projects. • Increase the budget of the NEST Programme to 500 MEuro. • Ensure that the SINAPSE eNetwork includes a forum for the promotion of interdisciplinary research, the dissemination of good practices, and the identification of emerging new fields. • Review the mechanisms used by EU and Non-EU research funding agencies to design, evaluate and manage interdisciplinary research. Publish an analysis of good practices / useful guidelines and incorporate findings into EU research programmes. |

“Knowledge is extracted from a fully integrated world. Knowledge is ‘dis-integrated’ by disciplinary units called Departments in Universities. How can knowledge, discovery and dissemination be re-integrated?”

Richard Zare, BioX initiative, Stanford University

1 INTRODUCTION

Many major breakthroughs in science take place at the boundaries or intersections of disciplines. While mono-disciplinary studies will continue to play an important part in both the training of researchers and in the conduct of research, the solution to many of today’s complex problems in areas such as globalisation, environment, health, defence and security must, by definition, be addressed using a multi-disciplinary approach. Indeed, the boundaries between the different disciplines are often largely historic and somewhat arbitrary and, as new fields such as in the biosciences area, have emerged, are becoming increasingly blurred.

There are many barriers, both institutional and systemic, to interdisciplinary¹ research and it is essential if the European Research Area (ERA) is to promote cutting-edge research, which opens up new areas of knowledge, that these barriers be removed. The problem is at its most acute at the fundamental end of the research spectrum. The traditional, one-department, one-discipline structures of most universities are also reflected in the structures of the research-funding bodies. The result is that unless specific action is taken, interdisciplinary research proposals tend to “fall between the cracks”. Research systems, which are weak in addressing such interdisciplinary needs, may miss research opportunities, fall behind in research areas and lose many of their most innovative researchers.

In the present context of rapid, interdisciplinary developments in areas such as the biotechnologies, nanotechnologies and complex environmental systems as well as in the social sciences, EURAB is concerned that Europe’s research systems have the policies and tools necessary to meet these challenges effectively. Such policies and tools for interdisciplinary research are a complement not a challenge to strong disciplinary research. The disciplinary structure, and the creation and acceptance of new disciplines, is fundamental to progress in modern science. Disciplines identify groups of experts, networks of specialists able to understand and comment critically on new research. They store and transmit this specialised knowledge. They provide funding and career structures. However, an intellectually isolated discipline quickly becomes a moribund discipline. Good interdisciplinary research structures not only open up new areas of research, but also provide flexibility and expansion possibilities for traditional disciplines. Interdisciplinary research arises in a variety of different ways from natural evolution into neighbouring disciplines, to the use of new research tools and technologies which open up new possibilities across disciplines, to the need to address complex problems which can only be solved by several disciplines working together.

¹ Definitions are many, varied, vague, and conflicting and often simply absent. Two terms seem reasonably well accepted – but sometimes difficult to distinguish in practice. 1) *Multidisciplinarity* – different disciplines working together but not trying to synthesise cognitive structures. Intellectually, they go home to their own discipline after work and 2) *Interdisciplinarity* – different disciplines working together and trying to synthesise cognitive approaches. We see this particularly in areas such as bioinformatics. However, in this paper, we use *interdisciplinarity* to cover both approaches.

2 THE PROBLEM

Developing interdisciplinary research can, however, face certain challenges:

- Funding flows from research funding agencies can be uncertain. Within universities, established funding and cost allocation systems may make the launch of new interdisciplinary research groups difficult.
- Interdisciplinary career structures may be weak, and outside mainstream university Departments
- New-field, interdisciplinary journals can take time to become established and attain high-impact status. There may be difficulties in establishing objective standards of excellence and quality systems.
- Colleagues may come from different backgrounds and it may take time to understand each other's approaches' and to establish effective working relations.
- Numbers in interdisciplinary areas tend to be small, initially lacking sufficient critical mass to establish the normal professional support structure (journals, international meetings,...)
- Undergraduate and even postgraduate systems are rarely geared to the needs of new interdisciplinary research areas. Obtaining good researchers may be difficult.
- And finally there is the general inertia of any established research system. Even with the availability of resources and general goodwill, take-up may be slow.

3 TACKLING THE PROBLEM

EURAB believes that such problems should be tackled at a number of levels:

- The definition of a discipline.
- Education and training of researchers
- University structures and policies
- Research funding institutions and systems

Interdisciplinary research includes the social sciences and humanities (SSH). Many major breakthroughs in the natural sciences as well as most technological developments have significant human and societal consequences. Many barriers to the adoption of new technologies are of a social, psychological or economic nature. And many problems can only be solved with research in the SSH. The EURAB report on "The European Research Area and the Social Sciences and Humanities" addresses specific issues related to interdisciplinary research and the role of SSH.

3.1 THE DEFINITION OF A DISCIPLINE

Under some research systems, strong de-facto and even legally binding definitions of research disciplines have been developed. The reduction of the number of these divisions into which research funding is allocated can be helpful in providing the opportunity for greater interdisciplinarity for:

- The research funding agency. Broader characterisation of research requirements can provide, when appropriate, broader research proposals and greater interdisciplinarity – for example in the trend for funding agencies to operate on “Thematic Areas” or “Problem Focused Research”, rather than exclusively along specific disciplinary lines.

- The research institution. Broader divisions can reduce resource allocation and ownership barriers to interdisciplinarity.
- The individual research appointment. Fewer recognised disciplines permit broader knowledge areas to be covered. In some Member States, appointing interdisciplinary professors outside a recognised discipline can be problematic.

EURAB Recommendations to the Commission Services:

- Ensure that any future European Union (EU) expert group / advisory board / working group systems, which are developed, do not create barriers to interdisciplinary research. Equally, in setting up internal administrative Programme Divisions and the definition of Work Programmes, care should be taken not to create barriers to interdisciplinary research.
- In the development of the Thematic Priority (“Vertical”) Work Programmes 1) balance the need for highly targeted Calls for Proposals with the need for interdisciplinary research and 2) investigate the need for cross-Priority and cross-Action Line Calls for Proposals. In the “Horizontal”, less-discipline defined, Calls for Proposals, ensure that evaluation panel composition and procedures move to a “broad discipline” approach.
- In working with Universities, encourage the examination of discipline-based, Departmental and Faculty divisions and associated employment procedures to ensure that they are not an unnecessary barrier to interdisciplinary research and that the means and facilities for such research can be guaranteed. Interdisciplinary research expressly includes the Social Sciences and Humanities.

3.2 EDUCATION AND TRAINING OF RESEARCHERS

All the evidence suggest that today’s graduates will change careers – including research careers – a number of times during their working lives. Thus

- At undergraduate level, there is a need to provide bridges and openings towards other disciplines².
- At postgraduate level, many new explicitly interdisciplinary training programmes have been launched. EURAB was particularly impressed by the NSF’s IGERT Programme³.
- Good research training requires an initial broad exposure to the manifold techniques and methodologies of the research area. This tends to vitiate the small, isolated and narrow research Department. Graduate Schools spanning a number of Departments, even a

² See, for example, the [“Experts in Teams”](http://www.ineer.org/Events/ICEE2001/Proceedings/papers/433.pdf) <http://www.ineer.org/Events/ICEE2001/Proceedings/papers/433.pdf> developments in the Norwegian University of Science and Technology.

³ The NSF Integrative Graduate Education and Research Traineeship Programme, the [IGERT Programme](http://www.nsf.gov/home/crssprgm/igert), <http://www.nsf.gov/home/crssprgm/igert>, focuses on the support of multidisciplinary Ph.D. programmes and aims to be a new model of “education and training that is innovative, flexible, and responsive to emerging research opportunities that cross-disciplinary boundaries”. Each IGERT project is an interdisciplinary grouping of PhD training awards and possibly associated new equipment. It is based at a U.S. university, though some are partnerships among several universities and international collaboration is encouraged. The Programme particular advantages of 1) funding different Departments to come together without having to use own-resources for non-Departmental work, and 2) providing long-term support to train high quality PhDs in a new area, 3) providing sufficient resources to develop critical, self-sustaining mass in a new area.

number of universities have been a successful training response in a number of Member States⁴.

- More generally, graduate PhDs entering industry require a much higher level of skills across different disciplines. Overspecialisation at a doctoral level creates barriers to industrial employment. These barriers need to be addressed. Opportunities for a broader skills base to PhD training, along with greater contact with industrial research should be explored. While examples such as the [Danish Industrial PhD Initiative](#)⁵ are well known, even traditional disciplines such as [Physics](#)⁶ have shown the ability to develop industrial interfaces for high quality PhD training.
- Finally, interdisciplinary training does not necessarily mean that a person becomes "interdisciplinary", rather that he/she is able to work well with other disciplines, appreciates and has respect for them, and is able and willing to seek them out when there is a need for an another discipline. It is important that an individual working on problems requiring such an interdisciplinary approach has a solid base, a "normal home" in one discipline. However, there is some evidence that this openness to interdisciplinary linkages and approaches becomes more difficult as one moves from a post-graduate to post-doctoral to principal investigator to professorial level⁷. Keeping channels of communication open to other disciplines is a continuing challenge throughout a researcher's life.

EURAB Recommendations to the Commission Services:

- Consider establishing, in conjunction with Member State authorities, a high level, EU Doctoral Programme in new, emerging areas, which cross discipline boundaries. Examine the NSF IGERT Programme as a model.
- Review recent developments in industry-based and industry-related doctoral training. Transfer good practices to develop Framework Programme Six (FP6) Programmes, including, in particular, the Marie Curie Programmes.
- In working with universities, develop programmes, which encourage Departments to provide the opportunity for undergraduates to take credit modules outside their own speciality and, in their final year, to participate in multidisciplinary project teams.
- In working with universities, encourage them, individually or as a local network, to develop Graduate School structures which, when required, can more easily span traditional disciplinary divisions in research training.

3.3 UNIVERSITY STRUCTURES AND POLICIES

The existing Departmental and Faculty structures are the accepted, administrative structure of universities. Most funds flow into and are allocated to the cells of this matrix. The structures are the most powerful directive to a young researcher on research specialisation and career opportunities. And professors and lecturers are employed into the disciplinary matrix. Buildings –

⁴ Such Graduate Schools have been the norm in the US for many years – a particularly interesting example of breadth and flexibility is the [Rand Graduate School](#) <http://www.rgs.edu/>. [GradSchools.com](#) "<http://www.gradschools.com/> provides the most used portal to US Graduate Schools.

⁵ <http://www.erhvervspd.dk/visArtikel.asp?artikelID=510>

⁶ <http://www.aip.org/pt/vol-53/iss-8/p39.html>

⁷ See, for example, Science, Vol.303, 13 Feb 2004, p.9 for data on such linkages.

or floors of buildings - often physically delineate the Departmental division of knowledge. Introducing flexibility into such structures is important in benefiting interdisciplinary research.

Virtual Research Centres.

Virtual research centres / networks / laboratories have been developed for many reasons; including opening up and strengthening interdisciplinary research areas.

- Within institutions, in administrative terms, researchers can remain within Departments, yet work in or contribute to the virtual research centre. Funding for consumables and overheads can be allocated to such centres. Examples include the [Weizmann Institute](http://www.weizmann.ac.il/)⁸ and [IUT of Compiègne](http://www.utc.fr/recherche/politique_recherche.html)⁹. Similarly, a matrix organization can also function to create “virtual labs” within a research institution. The Rand Corporation has traditional disciplines (a researcher's "permanent home") along one axis and interdisciplinary programs/projects along the other axis (a researcher's "place of time limited work").
- Inter-institutional virtual research centres are often set up between universities. Indeed, the EU's Networks of Excellence under FP6 already include many examples of “virtual laboratories” and “virtual research centres” set up on an international basis, and with explicit objectives of improving opportunities for interdisciplinary research. The EU's Information Society Technologies (IST) Programme has been developing such networks since FP4, but it is not clear the extent to which these networks were or are truly interdisciplinary.
- The [DFG's Research Centre Programme](http://www.dfg.de/en/research_funding/coordinated_programmes/dfg_research_centres/forschungszentren_kompaktdarstellung.html)¹⁰ provides an impressive example of developing longer-term, internationally visible, yet temporary focal point for interdisciplinary research using existing structures.

There is anecdotal evidence to suggest that it is often easier to collaborate with someone outside one's own discipline if they are in another institution. Thus interdisciplinary research is often also inter-institutional research. Careful evaluation of the success factors of such initiatives is necessary.

EURAB Recommendations to the Commission Services:

- Undertake an examination of good-practice and success factors in “virtual laboratories” and “virtual research centres” paying particular attention to their use in 1) the development of interdisciplinary research and 2) Networks of Excellence.

New Research Centres

The creation of new and specialised research centres / institutes, particularly within universities, is often associated with overcoming the more conservative elements of disciplinary structures and the development of either critical research mass or the interdisciplinarity needed for emerging research areas - or both. In addition, research centres working around particular capital equipment can make for high levels of interdisciplinarity.

⁸ <http://www.weizmann.ac.il/>

⁹ http://www.utc.fr/recherche/politique_recherche.html

¹⁰ http://www.dfg.de/en/research_funding/coordinated_programmes/dfg_research_centres/forschungszentren_kompaktdarstellung.html

However, over emphasis on such centres may denude the traditional, disciplinary Departmental structures of research vitality and cause difficulties in developing top-level undergraduate teaching. Establishment of Institutes outside universities – again sometimes undertaken to avoid conservative university structures – may compound such difficulties.

EURAB Recommendations to the Commission Services:

- Before co-funding the setting up new interdisciplinary research centres, balance their costs and benefits against the funding of the reform/extension of existing traditional disciplinary structures.
- In co-funding a new interdisciplinary research centre in a university, ensure that provision has been made for its integration with the teaching and research activities of the traditional disciplinary Departments.

Core/Shared Facilities

A frequently mentioned issue in developing interdisciplinarity is the difficulty of access to specialised equipment, which is administratively “owned” by another discipline. The main solution has been the development of core / central facilities which are at the disposal of the Faculty, university or even group of universities e.g. High Performance Computing and Visualisation Systems, imaging systems, animal testing facilities, etc. In addition, such facilities can be managed as “meeting grounds” for the different disciplines, as a practical research focus for interdisciplinary courses, and as a powerful driver for interdisciplinary research.

EURAB Recommendations to the Commission Services:

- When co-funding major research infrastructure and facilities, ensure structures and procedures are in place to permit the appropriate, intra-and inter-institutional access to such facilities. When appropriate, such core facilities should be encouraged to develop interdisciplinary training provision.
- Examine the possibility of extending the practices (particularly interdisciplinarity activities) developed in “Access to Research Infrastructures” to appropriate Thematic Priorities for use in Integrated Projects and Networks of Excellence.

3.4 RESEARCH FUNDING AGENCIES

Many research funding agencies, including the Commission Services, have been highly proactive and innovative in developing interdisciplinary research funding and promoting such work in research institutions. Initiatives have included:

- Funding from an individual research funding agency to employ an interdisciplinary group of researchers along with equipment funding¹¹. Less commonly, coordinated, large scale capital & recurring funding systems have been used to create strong interdisciplinary

¹¹ For example, the [CNRS Interdisciplinary Funding](http://www.cnrs.fr/DEP/prg/programme.html), <http://www.cnrs.fr/DEP/prg/programme.html>, requires coordination across a number of divisions – similarly [The NSF Crosscutting Interdisciplinary Programmes](http://www.nsf.gov/home/crssprgm) <http://www.nsf.gov/home/crssprgm> and associated centres. The National Institute of Mental Health has funded [Interdisciplinary Behavioural Science Centres for Mental Health](http://grants.nih.gov/grants/guide/pa-files/PA-00-130.html) <http://grants.nih.gov/grants/guide/pa-files/PA-00-130.html> with the specific objective of linking basic behavioural science to incorporate current approaches in neuroscience. Or the [National Cancer Institute’s Programme for Research Teams for Molecular Target Assessment](http://grants.nih.gov/grants/guide) <http://grants.nih.gov/grants/guide> also provides examples.

structures by requiring the establishment of inter-Departmental or inter-university cooperative structures¹².

- Joint funding of interdisciplinary research by two or more agencies has been more difficult, when the research areas involved are “owned” by different funders. Here, funding agencies with a full-spectrum responsibility have usually been more successful¹³. However, joint calls by funding agencies are becoming more common¹⁴, even at the international level¹⁵.
- Many research funding agencies operate on the basis of budgets allocated to the different disciplines/panels. This can be detrimental to interdisciplinary proposals unless specific action is taken. Solutions can include allocating a certain percentage of **each** panel’s budget or taking a percentage off the top of the ensure budget for interdisciplinary proposals.
- The development of a broader Call for Proposals has been important in developing interdisciplinarity. This can be seen in a move to Calls based on “research themes”, “key issues” or “solving key problems” rather than discipline-defined calls. Equally, calls such as under the [New and Emerging Science and Technologies](#)¹⁶ (NEST) Adventure Programme which are open to proposals which are explicitly not covered in mainstream thematic or discipline-based calls, can be particularly important in encouraging highly innovative (and generally also) high-risk interdisciplinary proposals.
- An interesting problem facing many research funding agencies including the NEST Pathfinder initiative is how to identify new interdisciplinary research themes. Traditional approaches tend to be based on conferences or workshops such as the Gordon Conferences or ESF Forward Looks, which bring together experts with a view to identifying new research themes for the future. An alternative approach, which has been used successfully by the Weizmann Institute, is to bring together experienced, senior researchers with young PhD students. In addition, bottom-up efforts at structured dialogues, such as seen in the Commission’s own (NEST) activity can be particularly helpful in integrating disciplinary and interdisciplinary research needs ahead of Calls for Proposals. The newly established [SINAPSE \(Scientific Information for Policy Support\)](#) eNetwork has a potential role in this area as well as providing an opportunity to disseminate good practices in interdisciplinary research¹⁷. Whatever approach is used, the challenge is to ensure that there is an appropriate mix of experienced discipline-based researchers who are open to interdisciplinarity¹⁸.

¹² See for example the Irish [PRTL Programme](#) <http://www.irishscientist.ie/2001/contents.asp?contentxml=01p16.xml&contentxml=IS01pages.xml>,

¹³ The FP’s [Cross-Programme Actions](#) <http://www.cordis.lu/ist/rn/cpa.htm> have been particularly innovative. Similarly, the breadth of the CNRS has been useful in broadening interdisciplinarity.

¹⁴ For example, [the UK Medical Research Council](#) http://www.mrc.ac.uk/index/strategy-strategy/strategy-partnerships_strategy/strategy-research_councils.htm, and particularly the work of [Research Councils UK](#) <http://www.rcuk.ac.uk/> as well as [the NSF](#) <http://www.nsf.gov/home/crssprgm>.

¹⁵ For example, the NWO, Research Council of Norway and NERC have come together for a joint call on Rapid Climate Change – *Nature*, 16th Oct 2003.

¹⁶ http://europa.eu.int/comm/research/fp6/nest/index_en.html

¹⁷ The SINAPSE eNetwork will shortly be accessible via the EUROPA website

¹⁸ It would be interesting to consider bringing together all the recipients of awards under the new EURI scheme with the specific remit of considering interdisciplinary research opportunities of the future.

- Most funding agencies have made significant adjustments to their peer review mechanisms to encourage greater interdisciplinarity¹⁹. Research funding agencies must ensure that they have the facility to evaluate interdisciplinary proposals appropriately.
- Finally, the provision of overheads can be an important stumbling block in developing interdisciplinary research. The funding systems of universities and funding agencies, which pay little or no research overheads, can create major barriers to the development of inter-Departmental and inter-disciplinary research. Where research overheads are paid, traditional academic departments and emerging units/centres can compete to claim this overhead. Conventional university accounting systems are not generally sufficiently comprehensive to provide full traceability of research costs (see also the EURAB Report, "Some Issues Affecting the Future of University Research in the EU", EURAB 02.051, Nov. 2002, Rec. 1).

EURAB Recommendations to the Commission Services:

- Ensure robust and transparent mechanisms are in place for reviewing both 1) the interdisciplinary elements of discipline focused proposals and 2) fully interdisciplinary proposals. This may include flexibility in the allocation of projects to discipline-based panels with cross-referencing and joint evaluation.
- Ensure that the structuring of Work Programme budgets does not discriminate against interdisciplinary projects.
- Enhance support for the NEST Programme, including doubling of the current overall budget which is about 235 MEuro).
- Ensure that the SINAPSE eNetwork includes a forum for the promotion of interdisciplinary research, the dissemination of good practices, and the identification of emerging new fields.
- Review the mechanisms used by EU and Non-EU research funding agencies to design, evaluate and manage interdisciplinary research. Publish an analysis of good practices / useful guidelines and incorporate findings into EU research programmes.

¹⁹ For example, the DFG has been reforming its [review committee structure](http://www.dfg.de/en/dfg_profile/structure/statutory_bodies/review_committees/changes). Similarly, the UK Research Councils' "Cross Council Research Forum" <http://www.rcuk.ac.uk/researchforum/peerreview.htm> has developed general principals for interdisciplinary peer review. The NEST Programme also operates a completely different evaluation mechanism from other FP6 programmes reflecting the bottom-up science-driven interdisciplinary nature of the programme.

4 CONCLUSIONS

“Knowledge is extracted (by disciplines) from a fully integrated world.”²⁰ Meeting the challenges – the pulling together of separate areas of knowledge and sometimes re-integrating and recasting them - which the disciplinary processes often create, is essential in keeping Europe at the forefront of scientific and technological research. Interdisciplinary research is - and has always been - a necessary feature of progress in scientific exploration. And universities, Research Funding Agencies and the European Commission Services play a critical role in providing researchers with the flexibility and appropriate resources to undertake such research. But there are a number of approaches, which could make interdisciplinary research support more effective without damaging traditional disciplinary structures.

We see three strategic issues in increasing the effectiveness of support: 1) A reassessment, where useful, of disciplinary demarcations, 2) A removal of institutional barriers to performing interdisciplinary research and 3) A rethinking of associated research training.

- Firstly - Broader definitions of disciplinary boundaries – implying fewer, formally defined, disciplines within a Department, within a Faculty, even within a University and Research Funding Agency - can sometimes be helpful in avoiding many of the administratively generated problems relating to interdisciplinary research, ranging from finance and employment issues to simple office allocation.
- Secondly – To undertake effective interdisciplinary research, certain structural and administrative barriers - within and between institutions – need to be removed or at least overcome. Structural change (broadening of discipline categories and associated employment practices, provision of core, non-discipline defined, research facilities, calls for proposals which are thematic/problem-based rather than disciplinary based) is probably most effective in removing barriers. However, administrative change (joint funding agency calls, better/fairer proposal evaluation systems, reserved funds for interdisciplinary research, even virtual laboratories) is also important in tackling, if not fully removing, many of the difficulties.
- Thirdly – Sustaining research progress depends on training the next generation and this takes a long-term commitment of time, finance and appropriate training facilities. The need for long-term commitment to interdisciplinary research training arose many times – and the NSF’s solution, the IGERT Programme was seen as a possible solution. In terms of training facilities, grouping disciplines into Graduate School structures seems to provide excellence in disciplinary and, when necessary, greater flexibility in providing interdisciplinary research training. Finally, and in the context of the “3% objective”, the relationship of the traditional doctoral training to industry needs to be re-examined, especially mobility from academic to industry positions.

These conclusions lead to a number of recommendations. The recommendations are made to the Commission Services in the context of 1) its work in developing European research potential within our universities, 2) in co-funding and working with other research funding agencies and, finally, 3) in its own funding of research and associated training.

²⁰ Richard Zare, BioX initiative, Stanford University.

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