The Canadian Journal of Program Evaluation Vol. 23 No. 1 Pages 179–200
ISSN 0834-1516

EVALUATING INTER-, MULTI-, AND TRANSDISCIPLINARY RESEARCH IN THE EUROPEAN RESEARCH AREA

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Abstract: Europe faces challenges in creating an integrated European Research Area. This article focuses on the use of research evaluations in a framework where knowledge production processes are changing and increasingly take place within inter-, multi-, and transdisciplinary settings. European research policies and instruments such as the Framework Programmes for Research and Technological Development and the recently established European Research Council are discussed in view of new knowledge production processes and evaluation practices. The article concludes with an explanation of the need to rethink evaluation approaches in the European Research Area.

Résumé : Cet article porte sur les défis auxquels l'Europe fait face pour créer un Espace européen de la recherche intégré. Il se concentre sur l'utilisation de recherches évaluatives dans un environnement où les processus de production de connaissances changent et se déroulent de plus en plus dans des cadres interdisciplinaires, multidisciplinaires, et transdisciplinaires. Les politiques européennes en matière de recherche et les instruments tels que les Programmes cadre pour la recherche et le développement technologique, ainsi que le nouveau Conseil européen pour la recherche font l'objet d'une discussion à la lumière des nouveaux processus de production de connaissances et pratiques d'évaluation. En conclusion, l'article explique la nécessité de repenser les approches d'évaluation dans l'Espace européen de la recherche.

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THE CONTEXT

Science and research are central themes on the European agenda. In 2000 the European Union (EU) decided to establish the European Research Area (ERA).[1] The ERA was recently relaunched in an effort to better meet global challenges by further improving research framework conditions in the enlarged EU with 27 member states. The European Commission very recently established the European Research Area Board, a high-level advisory group on research and science, in order to develop, promote, and evaluate policy initiatives and actions to meet the ERA objectives. The idea of the ERA came out of the recognition that European research suffers from three primary weaknesses: insufficient funding, lack of stimulating research environment and broader utilization of results, and the fragmented nature of activities and dispersal of resources. The intention behind the ERA was to move away from collaborative research and try instead to mobilize the entire research resource of Europe to reinforce competitiveness and contribute to the solution of socio-economic problems. Despite this, the European Commission[2] in the Green Paper on ERA (2007c) concludes that national and institutional barriers still prevent the ERA from becoming fully effective.

At the Lisbon and Barcelona European Councils in the beginning of this century, the EU's heads of states and governments launched a series of reforms by establishing an effective internal market and committing the member states to increase their investments in research to 3% of GDP (two thirds of which is expected to come from the private sector). Five years after the launch of the Lisbon Strategy, a mid-term evaluation of the strategy revealed that the results were mixed. Many member states had a long way to go to reach the target. Urgent action was therefore called for. In March 2005, the European Council relaunched the Lisbon Strategy and refocused priorities on growth and employment, placing the main emphasis on knowledge, innovation, and the optimization of human capital. However, not much progress has been made since 2000 toward the 3% objective (European Commission, 2007a, 2007b).

The EU through its own financing has additional tools to support cross-national and sectoral research and development activities. These are the Framework Programmes for Research and Technological Development (FPs), implemented since 1984. The chief instrument for funding research from 2007 to 2013 is the FP7[3] (dispensing a total of 55 billion euros, a considerable funding increase compared

to the previous FPs), designed to carry forward the ERA toward the knowledge-based economy. Under this umbrella, the following issues are central to the agenda:

- High expectations for the contribution of science and technology to socio-economic development
- Consolidation of the ERA through integration of European research and cross-national activities
- Quantitative and qualitative strengthening of human resources in science and technology
- Supporting research infrastructures, including research that benefits enterprises.

As seen from the above, it is obvious that the conviction of the EU is that boosting knowledge is the core element of research policy. In addition, new research production processes are acknowledged within both national and European settings. In this context, the discussion on valuation of research has been intensified. Evaluating and assessing research nowadays requires trans- and cross-disciplinary expertise as well as new instrumentation. In the ERA perspective, there is an increased demand for evaluations as expectations for science and technology outcomes and solutions to socio-economic problems are greater than ever. The interest in evaluations and use of evaluations in policymaking in particular after the adoption of the Lisbon Strategy is growing as EU member states nowadays perceive research in a European context (European Commission, 2007b).

Integrating research in the ERA puts new demands on evaluations that need to be addressed now if Europe is to achieve the objective of becoming the most competitive economy in the world (cf. Kalpazidou Schmidt, 2006).

In this article, the term *evaluation of research* is perceived as a broad concept, first and foremost connected to the process of research funding and evaluation of research process and outcome.

The article consists of six sections. In section 2, the use of evaluations in the European research agenda is discussed. Section 3 and 4 focus on the changing knowledge production process and the challenges of evaluating inter-, multi- and transdisciplinary research. In section 5, the centre of attention is the challenges European universities envisage in the ERA. Concluding remarks are presented in the final section.

EVALUATION AND THE EUROPEAN RESEARCH AGENDA

European research, although of excellent quality, is lagging behind in exploiting scientific results. As a consequence, industry and in particular small and medium-size enterprises have been reluctant to invest in research and technological development. This was the rationale behind the implementation of a series of EU Framework Programmes for Research and Technological Development and in particular the most recent FP6 and FP7 (cf. Caracostas & Muldur, 1997; European Commission, 2005b).

FP6 (2002–2006) served two main strategic objectives: to strengthen the scientific and technological bases of industry and to encourage international competitiveness while promoting research activities in support of other EU policies. In FP6, new instruments (such as Integrated Projects, Networks of Excellence, and Coordination Activities)[4] were introduced to achieve stated objectives. These instruments are also relevant in the recently launched FP7. The introduction of new research policies and instruments in FP6, in the early ERA concept, has had implications both for policy implementation and for evaluation (cf. Edler, Kuhlmann, & Behrens, 2003; Kuhlmann, 2002).

Evaluation policy and practice have gradually shifted from focusing on collaborative research and technology programs in the 1980s toward integration of research and innovation capacities, building of human resources and mobility structures, and infrastructure and networks (cf. Georghiou, 1995). The policy of integrating European research in the ERA through new instruments has generated challenges, among others for evaluation, as new approaches to assess impacts of integration have to be considered (Kalpazidou Schmidt, 2006).

Evaluation of research processes and outcomes is gaining importance as substantial funds are reallocated to research, particularly in the FP7 context. At the same time demands for accountability are increasing. However, studies reveal that a common evaluation ground is not yet seen in Europe (Kalpazidou Schmidt, 2006; Siune & Kalpazidou Schmidt, 2003). Evaluation landscapes vary among European countries in terms of contexts, history, and paradigms. Evaluation practices also vary with respect to the actors involved and the types of issues and problems that countries deal with. As a consequence, initiations, processes and outcomes, impacts, and learning differ from country to country. Some European countries make systematic use of evaluations (Nordic countries, the UK) and have

established public evaluation institutions (Austria, Denmark, France, Germany, Poland, Spain) and formulated specific evaluation standards (Austria) (Kalpazidou Schmidt, 2003, 2006; Platform FTeval, 2003). Other countries initiate evaluations and develop standards on an ad hoc basis. It is acknowledged, however, that little information exists on how research evaluation is practiced at the national level. Insights into the dynamics of national contexts are essential to the development of practices at the European level and enhancement of common evaluation strategies to strengthen the ERA (Kalpazidou Schmidt, 2003, 2006).

Most European countries evaluate their research and development (R&D) performance and participation in the FPs, a development confirmed by the latest studies (Kalpazidou Schmidt & Siune, 2006; Siune & Kalpazidou Schmidt, 2003). Some countries (such as the Nordic countries) have extensive evaluation traditions and have developed competences, in particular the UK, where evaluation of research departments is common (Georghiou, 2001b; Rojo, 2002). In Germany, the major research and technology organizations have been subject to system evaluations. In France, a tradition for evaluation of institutions, research capacities, and research councils exists (Rojo, 2002). However, the French evaluation system is transforming.

Georghiou (2002) has classified the European national R&D systems in terms of legislative systems and frameworks, which influence their research evaluation cultures, as follows: (a) countries with centralized frameworks (such as the UK and France); (b) countries where evaluation is well established but uncoordinated among ministries and agencies (Germany and the Netherlands), which has an impact on coordination of activities and policy at the national level; (c) Nordic countries where the evaluation culture has a long tradition and usually involves foreign panelists; and (d) countries (mainly in Southern Europe) with inflexible science policy legislation that leaves little room for an evaluation culture. However, evaluation cultures have become more mixed due to increasing exchanges of experiences but also the influence of practices of the European Commission (Georghiou, 2002; Luukkonen, 2002).

In general, evaluation in Europe is primarily used to review outcomes against stated objectives, and the introduction of reforms of national research and innovation systems has generated greater reliance on evaluation results for allocating resources among R&D actors (Georghiou, 2001a). As such, there are consolidated experiences

(European Commission, 1997, 2000a, 2000b, 2005b; Fayl, Dumont, Durieux, Karatzas, & O'Sullivan, 1998; Georghiou, 1995; Georghiou, Rigby, & Cameron, 2002; Siune, Kalpazidou Schmidt, & Aagaard, 2005a, 2005b) in the evaluation of the Framework Programmes, the Five-Year Assessments, and evaluations of specific R&D programs. In addition, evaluation networks[5] are supported, and conferences and workshops on these themes are being organized. Experiences from the evaluation of the previous FPs have been used in the creation of FP7, and for the first time an *ex ante* evaluation of an FP was conducted in 2006 in order to assess strategies and policies for the coming program. Evaluations at the European level are increasingly perceived in a policy cycle context that includes several levels (a strategic level for design, a management level for implementation, interim evaluation and transfer of results, the level of the target group), where evaluation is one stage in the policy process. Evaluation is hence seen as a practice-driven approach and is taken into consideration from the beginning of the process in order to generate information to be fed back into policy-making. Evaluation can thus inform strategy in combination with other approaches and analytical tools (Platform FTeval, 2003; Shapira & Kuhlmann, 2003).

Based on studies of the European landscape, Luukkonen (2002) concludes that "there is no single way of doing research evaluation in Europe." Georghiou and Kuhlmann (2002, p. 235) hence suggest, "It could be argued that the development of a European Research Area requires a corresponding development of a 'European Evaluation Area' in which there is a common methodological and procedural understanding that allows members to accept and validate each other's findings."

Knowledge production is rapidly changing, and so is the framework of R&D activities as the relationship between science and society.[6] Diversity in evaluation activities and traditions among EU member states and lack of coordination point to the need for further insight in evaluation practices in order to develop systematic and coordinated evaluation approaches, particularly in light of the ERA. A common European understanding of evaluation procedures and methods is a precondition for research integration in the ERA.

THE CONCEPTS OF INTER-, MULTI-, AND TRANSDISCIPLINARITY

New knowledge production processes have put the notions of inter-, multi-, and transdisciplinarity on the European research and policy

agenda. The definition of the concepts is not straightforward, however, and perceptions are often fuzzy. There is, though, an ongoing epistemological debate,[7] which may add to the understanding of the concepts. In order to shed light on the differences between the concepts, a typology is presented and discussed below (cf. European Commission, 2004).

Interdisciplinarity addresses an issue from different disciplinary perspectives, and contributions of various disciplines are integrated to provide a holistic or systemic outcome. Interdisciplinarity may best be understood by referring to its two modes of operating. The first mode of operating aims to further the expertise and competence of academic disciplines themselves, for example through methodological developments, which enables new issues to be addressed or new disciplines or subdisciplines to be formed. Examples of this kind of interdisciplinarity are the new technologies that promote the creation of new disciplines. The second operating mode refers to research that addresses issues of social, technical, and/or policy relevance where problem-oriented and discipline-related outcomes are less central to the research design.

Multidisciplinarity refers to a setting in which each researcher's work is based on a relatively self-sufficient approach but with flexibility in relation to other disciplines. Multidisciplinary research approaches an issue from a range of disciplines, but each discipline works in a self-contained manner with little cross-fertilization, or synergy in the outcomes. Multidisciplinarity does not challenge the structure of established disciplines and does not require changes in the worldviews of involved researchers.

Transdisciplinarity focuses on processes of knowledge production transcending the disciplinary structure and considers the interaction between disciplines that brings about radical epistemological rethinking. In other words, transdisciplinarity overcomes the narrow areas of disciplines, but does not lead to new disciplines and cannot replace disciplines. Transdisciplinarity is thus perceived as apart from discipline-based structures. It is a new mode of cooperation that leads to changes in the outlook of disciplines and becomes operative wherever it is impossible to define or solve problems within the boundaries of existing disciplines. Transdisciplinarity often arises in cases concerning the solution of non-pure scientific problems, that is, energy, environment, and health related problems.

Growing interest in inter-, multi-, and transdisciplinary research has intensified the debate on the enhancement of methods to evaluate research. Some researchers argue that inter-, multi-, and transdisciplinarity is an outcome, rather than a cause, of dynamic and pioneering research and therefore should be rooted in disciplinary excellence and hence evaluated on this ground (cf. Weingart, 2000). Others argue that most major advancements in modern science involve multiple disciplines and go beyond disciplinary boundaries (cf. Gibbons et al., 1994; Moran, 2002; Thompson Klein, 1993). Accordingly, evaluations should take into consideration the specificity of such research and apply different criteria. In the following section the relationship between the concepts presented above and evaluation is discussed in the framework of European research policy.

EVALUATIONS AND INTER-, MULTI-, AND TRANSDISCIPLINARITY IN EUROPEAN RESEARCH POLICY

Interdisciplinary integration became a key element of European research policy for the first time in FP5 (1998–2002) and is considered an essential contributor to success within environmental protection, technological innovation, socio-economic development, and improved competitiveness. Despite this achievement, there is only limited research from which recommendations, evaluations, and further initiatives within inter-, multi-, and transdisciplinary research could be based.

Tait et al. (2003) reveal that some concerns regarding evaluation of interdisciplinary activity were expressed among researchers participating in FPs. According to critics, evaluators lacked the breadth of expertise needed to assess the contribution of proposers with different disciplinary backgrounds, particularly in cases where both natural science and social science were involved. Greater attention to the variety of expertise was asked for, in particular increased involvement of evaluators with interdisciplinary experience who were able to evaluate the validity of decisions on discipline selection and the effectiveness of the integration process proposed in projects. There is good reason to believe that multi- and transdisciplinarity face similar problems, as the reservoir of potential evaluators with the required expertise is limited.

Despite efforts at the European level to minimize such bias in evaluation of proposals, researchers' experience has been that interdisciplinary approaches face greater uncertainties in selection processes

than those that are discipline-based. Administrators and evaluation panels are often dominated by monodisciplinary experts.

In general, the problem with European FP evaluations is the excessive emphasis on administrative control, and on the transparency and efficiency of the implementation process instead of focusing more on the content in the evaluations conducted. Moreover, the dominant use of peer reviews boosts the risk for conservatism because peers, due to their expertise in narrowly specialized science fields, are not always equipped to handle or fit for evaluations of new and emerging approaches. A high-level panel of independent experts assessing the instruments used in the FPs concludes that the quality of evaluators requires more attention and suggests improvements in the selection process of experts (Marimon, 2004).

The complexity of the EU with, at present, 27 sovereign member states requires special skills for evaluations (e.g., knowledge of cultural, structural, and scientific tradition differences). In addition, the EU ought to address requests for early evaluations in situations where short-term funding is provided. Long-term perspective in funding and evaluation is also needed if expertise and infrastructure are to be further developed in the ERA, yet a short-term perspective is often used in evaluations across the EU.

In this framework, it is highly relevant to pursue the implications of the most recent instrument used in the ERA integration—the European Research Council (ERC)—on new research production processes and evaluation procedures.

The Establishment of the European Research Council and Its Implications for Inter-, Multi-, and Transdisciplinarity

The establishment of the ERC is one of the most important science policy instruments the EU has initiated to address the issue of European research integration. The ERC started operations in 2007 and is perceived as a component of the ERA. As such, it complements existing EU member states' research-funding bodies. The aim of the ERC is to encourage and support fundamental and innovative frontier research. The ERC will address manifold challenges such as staying ahead in scientific and technological research in a competitive international environment and reinforcing excellence, particularly in new, emerging, and fast-growing fields of science—among others inter-, trans-, and multidisciplinarity (European Commission, 2005c).

By funding research through a European-wide competition, the ERC could provide added value beyond what can be achieved at the national level by (a) open competition and better evaluation at the European level, (b) channeling funds into new and promising research areas with a focus that is not always possible within national funding systems, (c) conferring status and visibility on researchers, and (d) catalyzing the adaptation of national research structures to the emerging ERA.

Achievement of the above objectives may have important implications for funding bodies, funding mechanisms, and evaluation criteria, at both the national and European levels.

The ERC is expected to have a flexible structure that can quickly react to emerging research developments, inter-, multi-, and transdisciplinarity. National funding systems are usually based on traditional scientific disciplines that emerged in the 19th century, which rarely prioritize inter-, multi-, or transdisciplinary and original or "risky" research and typically support already established researchers. They are as such often reluctant to fund early-stage researchers with ground-breaking ideas. The ERC has the opportunity to build up competences within inter-, multi-, and transdisciplinary research. The new body may pursue research without taking established disciplinary boundaries or national borders and priorities into account.

The activities of the ERC could bring new actors to the European scene, for example from newer member states where scientific excellence can not be sufficiently supported due to lack of critical mass or other reasons (lack of recognition of original research and unconventional approaches). Furthermore, the ERC could support projects beyond the economic and scientific capacity of one single country.

Another important factor is the visibility and status that funding from the ERC may have for universities and research areas. In this setting, it is likely that inter-, multi-, and transdisciplinarity may achieve higher visibility. High quality peer-review-based evaluations will probably help member states intensify attempts to pursue new research and evaluation practices. This might lead to enhanced and more transparent evaluation procedures and selection criteria (encouraging, among others, inter- and multidisciplinarity or focusing on bolder projects) at the national level. A very recent example of the impact of the ERC's activities on a national level is the launch of intitiatives in France, Italy, Spain, Sweden, and Switzerland to offer the possibility of financial support to finalists of the first ERC

Starting Grant competition whose proposals have not been funded by the European body due to budgetary limits. These initiatives are an acknowledgement at the national level of the quality of the ERC's evaluation mechanisms.

It is worth noting that the ERC operates with the concept of "frontier research," reflecting a new understanding of research as an intrinsically risky venture, characterized by the absence of disciplinary boundaries. The basis for the peer review evaluation process is a structure of high-level panels, and attention is given to including panelists whose research interests are cross-disciplinary. The ERC Scientific Council emphasizes:

> The predominantly disciplinary panel structure should not militate against the evaluation of proposals which straddle the borders between disciplines and emerging, unconventional research, which should indeed be encouraged. The broad remit of panels should allow some proposals crossing disciplinary borders to be considered within each panel; in cases of more radical cross-disciplinarity, two different panels could consider proposals. (Scientific Council of the European Research Council, 2006, p. 4)

The ERC evaluation practice may hence be a stimulus for inter-, multi- and transdisciplinarity. The synthesis of the evaluation panels is therefore crucial in this aspect.

These are some observations on the implications for European research of the establishment of the new funding body. There are still other scenarios: for example, the potential for cutbacks in national funding in countries that do not recognize the complementary nature of the new institution. However, there are no indications that this will be the case. On the contrary, as described above, the latest development at the national level shows the opposite.

Other questions remain in relation to the role of the ERC in the ERA. Nonetheless, evaluation is central to the process of creating a coherent and coordinated approach to research activity and policy in Europe. The establishment of ERC evaluator panels, peer-review processes, and implementation methods to enhance quality are likely to have implications on evaluations at the national level, on the overall development of evaluation procedures and standards, and hence on integration of research in the ERA (cf. Kalpazidou Schmidt, 2006).

CHALLENGES FOR THE EUROPEAN UNIVERSITIES

Universities are clearly key actors in building a knowledge-based European society. The need to modernize the universities, giving attention not only to the role of universities in the success of the Lisbon Strategy but also to the wider move toward the global economy, is hence acknowledged. One recent initiative at the European level has been the establishment of the European Institute of Innovation and Technology (EIT). The EIT started its activities in 2008. Its working method will be based on trans- and multidisciplinarity, as well as partnerships between universities and business (European Commission, 2006, 2008).

It is obvious that this initiative alone cannot be the solution in the effort to modernize Europe's universities. There are approximately 4,000 universities in the EU—nearly half of which aspire to be research active—over 17 million students, and 1.5 million staff, of whom 435,000 are researchers. In comparison, fewer than 10% of higher education institutions in the US award postgraduate degrees, and even fewer can be considered as research-intensive universities. The comparative potential of the European universities could be better exploited. On the other hand, EU member states perceive universities as national competences and attach value to preserving them at the national level. In many European countries, procedures for recognition of qualifications and academic degrees obtained abroad still involve a high degree of bureaucracy. Academic mobility across the continent is thus hampered by national administrative regulations.

In addition, it is evident that some European universities have not fully acknowledged that research is no longer an isolated monodisciplinary activity and that a number of scientific problems go beyond the boundaries of traditional disciplines and sectors. Today, cutting-edge research is increasingly being conducted in the interface between disciplines or in multidisciplinary settings.

There is an apparent asymmetry between addressing contemporary scientific and societal problems and the disciplinary structure upon which most universities are based. It is recognized that competencies obtained in established disciplines are a precondition for tasks defined inter- and multidisciplinarily, but that might not be sufficient to effectively tackle innovative research. These challenges to universities might lead to organizational restructuring (cf. European Commission, 2005a).

Scientific organizations—including universities—must take into consideration that knowledge production processes have impact on institutional structures. In a number of universities the general practice is that research requirements seldom shape institutional frameworks. On the contrary, existing settings are often looking for suitable research to fit in. This might be counterproductive for university-based science systems. However, there are institutional signs of inter-, multi-, and transdisciplinary research activity such as the changing emphasis on this type of research in policies and organizational settings, that is, the organization of inter-, multi-, and transdisciplinary university departments, centres, and programs or, in some cases such as Denmark, the non-discipline-based organization of national research councils (cf. Cunningham, 1999; Danish Institute for Studies in Research and Research Policy, 2002; Thompson Klein, 1996; Weingart & Stehr, 2000).

Increasing inter-, multi-, and transdisciplinarity may have far-reaching institutional and organizational consequences, as seen also in thematically organized research centres such as the joint Nanotechnology Research Centre in Spain/Portugal.

Another factor hampering publication of inter-, multi-, and transdisciplinary research in particular is the fact that high-level scientific journals are usually discipline-based. Individual or team-oriented evaluation typically pays attention to the number of publications in scientific reviews carried out within monodisciplinary contexts. Other factors that discourage the new type of knowledge production at universities include the limited training of doctoral students, poor career prospects for academic inter-, multi-, and trandisciplinary researchers, lack of recognition of such research, and few opportunities to publish this type of research in high-ranking refereed journals (cf. Tait et al., 2003).

CONCLUDING REMARKS

There are heightened expectations for science in the ERA, not least with regard to interaction with society and solving of socio-economic problems, calling for enhanced inter-, multi-, and transdisciplinarity. In this context, it is important to question the use of traditional evaluations in new and emerging fields of science. Not all research, in particular non-established research, fits the traditional evaluation practice with rigid monodisciplinary peer review orientation. Enhanced evaluation instrumentation and expertise are therefore

required in the effort to integrate the ERA. Evaluations will have to be developed as instruments better able to handle the new knowledge production approaches, increasingly involving inter-, multi-, and transdisciplinarity. It is necessary to build a framework that fosters environments encouraging new fields of science.

It is essential to develop policies and enduring agendas, not least at the European Union level, that create space for researchers to pursue inter-, multi-, and transdisciplinarity, supported by appropriate structures and new bodies. At the national funding agency and research council levels, structures and policies are important instruments to induce and facilitate increased inter-, multi-, and transdisciplinarity.

Another important instrument is evaluation capacity building and development of expertise within this type of research. Greater attention to the range of expertise used in evaluations and to the selection process of evaluators may provide the required breadth of expertise capable of assessing other than solely monodisciplinary research. Sharing of experiences and identification of good practices in selection processes and panel compositions could strengthen openness toward innovation of disciplinary settings.

Consideration of incentives at the level of the researcher/team is also necessary, in order to limit the risk of marginalization of non-monodisciplinary research. Such incentives comprise enhanced research training, opportunities to publish results in refereed journals, better career opportunities, and mobility.

Finally, it is vital to further stimulate the epistemological debate by organizing conferences and workshops, with the participation of monodisciplinary researchers as well, and by creating other forums for debating evaluation of inter-, multi-, and transdisciplinarity in the ERA.

There are many new challenges in the ERA that call for rethinking concepts and practices. To be fully functional, inter-, multi-, and transdisciplinarity require a change of culture at all levels of the research system. There is awareness of the challenges, but attempts to address them are fragmented and uncoordinated. So far there is no common approach to evaluation of inter-, multi-, and transdisciplinary research in the ERA framework.

Research integration in the ERA, new knowledge production processes, and the multiplicity of stakeholders involved in R&D obviously

require a broader reconsideration of evaluation approaches and competence building. Europe has not yet seen a coordinated approach to research evaluation.

NOTES

1. The objectives of the ERA initiative combine three related and complementary concepts: the creation of an "internal market" in research—an area of free movement of knowledge, researchers, and technology, with the aim of increasing cooperation, stimulating competition, and achieving a better allocation of resources; a restructuring of European research, in particular by improved coordination of national research activities and policies; and the development of a European research policy that not only addresses the funding of research activities, but also takes account of all relevant aspects of other EU and national policies.

2. The *European Commission* is independent of national governments. Its task is to represent and uphold the interests of the EU as a whole. It drafts proposals for new European laws, which it presents to the European Parliament and the European Council. It is also the EU's executive arm responsible for implementing the decisions of Parliament and the Council. Like the Parliament and Council, the European Commission was set up in the 1950s under the EU's founding treaties. The *European Parliament* is elected by the citizens of the European Union to represent their interests. Its origins go back to the 1950s and the founding treaties, and since 1979 its members have been directly elected by the people they represent. Elections are held every five years, and every EU citizen who is on an electoral roll is entitled to vote. Parliament represents the interests of the Union's citizens (more than 490 million) in discussions with the other EU institutions. The present parliament has 785 members from all EU countries.

3. FP7 is designed as a key contribution to the relaunched Lisbon Strategy. The new elements in FP7 are emphasis on research themes rather than on "instruments"; simplification of its operation; focus on developing research that meets the needs of European industry; establishment of the European Research Council; integration of international cooperation in all four programs; development of regions of knowledge; and a risk-sharing finance facility aimed at fostering private investment in research. The broad objectives of FP7 have been grouped into four categories: cooperation, ideas, people, and capacities. For each type of objective, there is a specific program corresponding to the main areas of EU research policy.

4. The new instruments under FP6 comprise (a) the Integrated Projects, designed to create the knowledge required to implement the priority thematic areas of FP6 by integrating a critical mass of activities (research, demonstration, training, innovation, management) and resources (staff, skills, competences, finances, infrastructure, equipment, etc.); (b) the Networks of Excellence, designed to tackle the fragmentation of research activities in Europe; and (c) an instrument, known as Article 169, to support the opening and joining of national research programs of member states.

5. One such network is the European RTD Evaluation Network, established in 1997 (by the European Commission, Directorate General Research), consisting of national research evaluation experts from EU member and associate states to promote dialogue between the producers and users of RTD evaluations. Over the last years, the scope of the network's activities has been changed toward improving coherence between national evaluations and ERA objectives.

6. Changes in the relationship between science and society have been addressed in a number of publications in the field of science studies by Etzkowitz and Leydesdorff (2000), Gibbons et al. (1994), Martin (2003), Nowotny, Scott, and Gibbons (2001), and Ziman (1994, 2000).

7. The concepts of discipline, inter-, multi-, and transdisciplinarity have been addressed in a number of publications (see Aboelela et al., 2007; Balsiger, 2004; Becher, 1981, 1989; Beghtol, 1998; Bruun, Hukkinen, Huutoniemi, & Thompson-Klein, 2005; Danish Institute for Studies in Research and Research Policy, 2002; Gibbons & Nowotny, 2001; Hirsch Hadorn et al., 2008; Lee & Bozeman, 2005; Max-Neef, 2005; Moran, 2002; Schummer, 2004; Thompson Klein, 1990, 1996, 2004; Weingart & Stehr, 2000).

REFERENCES

Aboelela, S.W., Larson, E., Bakken, S., Carrasquillo, O., Formicola, A., Glied, S.A., et al. (2007). Defining interdisciplinary research: Conclusions from a critical review of the literature. *Health Research and Educational Trust, 42*(1), 329–346.

Balsiger, P.W. (2004). Supradisciplinary research practices: History, objectives and rationale. *Futures, 36*(4), 407–421.

Becher, T. (1981). Towards a definition of disciplinary cultures. *Studies in Higher Education, 6*(2), 109–122.

Becher, T. (1989). *Academic tribes and cultures*. Milton Keynes, UK: Open University Press.

Beghtol, C. (1998). Knowledge domains: Multidisciplinarity and bibliographic classification systems. *Knowledge Organization, 25*(1–2), 1–12.

Bruun, H., Hukkinen, J., Huutoniemi, K. & Thompson Klein, J. (2005). *Promoting Interdisciplinary Research. The Case of the Academy of Finland*. Publications of the Academy of Finland 2005/8. Helsinki.

Caracostas, P., & Muldur, U. (1997). *Society the endless frontier: A European vision of research and innovation policies for the 21st century*. Brussels: European Commission EUR 17655.

Cunningham, R. (Ed.). (1999). *Interdisciplinarity and the organisation of knowledge in Europe*. Proceedings of a conference, Cambridge, September 1997. Luxembourg: Office of Official Publications of the European Communities.

Danish Institute for Studies in Research and Research Policy. (2002). *The design and delivery of inter and pluri-disciplinary research. Proceedings from MUSCIPOLI Workshop Two*. STRATA accompanying measures: Managing with uncertainty in science policy, Report 2002/7. Aarhus, Denmark: Author.

Edler, J., Kuhlmann, S., & Behrens, M. (Eds.). (2003). *Changing governance of research and technology policy: The European Research Area*. Cheltenham, UK: E. Elgar.

European Commission. (1997). *Five-year assessment of the European Community RTD Framework Programmes, EUR 17644*. Luxembourg: Office for Official Publications of the European Communities.

European Commission. (2000a). *Comments of the Commission on the conclusions of the RTD Framework Programmes 5-year assessment, COM(2000) 659 final*. Luxembourg: Office for Official Publications of the European Communities.

European Commission. (2000b). *Five-year assessment of the European Union research and technological development programmes, 1995–1999, EUR 19426*. Luxembourg: Office for Official Publications of the European Communities.

European Commission. (2004, April). *The Europe of knowledge 2020: A vision for university-based research and innovation*. Proceedings of a conference, Liège, Belgium. DG Research.

European Commission. (2005a). *European universities, enhancing Europe's research base*. Brussels: Forum on University-based Research.

European Commission. (2005b). *Five-year assessment of the European Union research framework programmes 1999-2003*. Luxembourg: Office for Official Publications of the European Communities.

European Commission. (2005c). *High-Level Expert Group report: Frontier research, the European challenge*. Retrieved May 30, 2007, from <http://ec.europa.eu/research/future/pdf/hleg_fullreport_frontier_research_april2005.pdf>

European Commission. (2006). *Communication from the Commission to the Council and the European Parliament: Delivering on the modernisation agenda for universities: Education, research and innovation*. COM (2006) 208 final. Brussels: Author.

European Commission. (2007a). *Commission staff working document accompanying the Green Paper, The European Research Area: New Perspectives*. Com (2007) 161. Retrieved April 10, 2008 from < http://ec.europa.eu/research/era/pdf/era_swp_final.pdf>

European Commission. (2007b). *Communication from the Commission to the spring European Council. Strategic report on the renewed Lisbon strategy for growth and jobs: Launching the new cycle (2008–2010). Keeping up the pace of change.* Com (2007) 803, final part I. Brussels: Author.

European Commission. (2007c). *Green Paper on ERA*. Retrieved June 1, 2007, from <http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf>

European Commission. (2008). *European Institute of Innovation and Technology*. Retrieved April 14, 2008, from <http://ec.europa.eu/eit/backg_en.htm>

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From national systems and "Mode 2" to a triple helix of university-industry-government relations, *Research Policy, 29*(2), 109–123.

Fayl, G., Dumont, Y., Durieux, L., Karatzas, I., & O'Sullivan, L. (1998). Evaluation of research and technological development programmes: A tool for policy design. *Research Evaluation, 7*(2), 93–97.

Georghiou, L. (1995). Assessing the Framework Programmes: A meta-evaluation. *Evaluation, 1*(2), 171–188.

Georghiou, L. (2001a, November). *Evaluation in the balance: Matching methods and policy needs*. Paper presented at the International Best Practices in Evaluation of Research in Public Institutes and Universities Conference, Brussels. <www.cordis.lu/belgium/12112001_prog.htm>

Georghiou, L. (2001b). The United Kingdom national systems of research. In P. Laredo & P. Mustar (Eds.), *Research and innovation policies in the new global economy* (pp. 253–296). Cheltenham, UK: Edward Elgar.

Georghiou, L. (2002). Evaluation of research and innovation policy in Europe: New policies, new frameworks? In P. Shapira & S. Kuhlmann (Eds.), *Learning from science and technology policy evaluation: Experiences from the United States and Europe* (pp. 65–80). Cheltenham, UK: Edward Elgar.

Georghiou, L., & Kuhlmann, S. (2002). Future policy instruments: Evaluation of the socioeconomic effects in the European Research Area. In G. Fahrenkrog, W. Polt, J. Rojo, A. Tübke, & K. Zinöcker (Eds.), *RTD evaluation toolbox: Assessing the socioeconomic impact of RTD policies, EUR 20382* (pp. 232–242). Seville: Joint Research Centre, Institute for Prospective Technological Studies. <www.epub.jrc.es/docs/EUR-20382-EN.pdf>

Georghiou, L., Rigby, J., & Cameron, H. (Eds.). (2002). *Assessing the socioeconomic impacts of the Framework Programme*. Manchester, UK: Manchester Business School, PREST. <www.mbs.ac.uk/research/centres/engineering-policy/publications/reports.htm>

Gibbons, M., Limoges, C., Nowotny, S., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. London: Sage.

Gibbons, M., & Nowotny, H. (2001). The potential of transdisciplinarity. In J. Thompson Klein, W. Grossenbacher-Mansuy, R. Häberli, A. Bill, R.W. Scholz, & M. Welti (Eds.), *Transdisciplinarity: Joint problem solving among science, technology, and society* (pp. 67–80). Basel, Switzerland: Birkhäuser.

Hirsch Hadorn, G., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., et al. (Eds.). (2008). *Handbook of transdisciplinary research*. Heidelberg, Germany: Springer.

Kalpazidou Schmidt, E. (2003). Evaluation and science policy. In K. Siune & E. Kalpazidou Schmidt (Eds.), *The use of evaluations in Europe* (pp. 7–36). Report from the European RTD Evaluation Network meeting,

Report 2003/2. Aarhus, Denmark: Danish Institute for Studies in Research and Research Policy.

Kalpazidou Schmidt, E. (2006). RTD evaluation and policy in the European Research Area. *Evidence & Policy: A Journal of Research, Debate and Practice, 2*(2), 185–209.

Kalpazidou Schmidt, E., & Siune, K. (2006, April). *Common evaluation needs and possible joint approaches*. Paper presented at the European RTD Evaluation Network Meeting, Vienna, Austria.

Kuhlmann, S. (2002). Distributed techno-economic intelligence for policy-making: Evaluation of government funded R&D activities. In G. Fahrenkrog, W. Polt, J. Rojo, A. Tübke, & K. Zinöcker (Eds.), *RTD evaluation toolbox: Assessing the socioeconomic impact of RTD policies* (pp. 210–231). EUR 20382. Seville, Spain: Joint Research Centre, Institute for Prospective Technological Studies.

Lee, S., & Bozeman, B. (2005). The impact of research collaboration on scientific productivity. *Social Studies of Science, 35*, 673–702.

Luukkonen, T. (2002). Research evaluation in Europe: State of the art. *Research Evaluation, 11*(2), 81–84.

Marimon, R. (2004). *Evaluation of the effectiveness of the new instruments of Framework Programme VI; Observations and recommendations of the High Level Panel of Independent Experts concerning the new instruments of the 6th Framework Programme*. Brussels, Belgium: European Commission.

Martin, B.R. (2003). The changing social contract for science and the evolution of the university. In A. Geuna, A.J. Salter, & W.E. Steinmueller (Eds.), *Science and innovation: Rethinking the rationales for funding and governance* (pp. 7–29). Cheltenham, UK: Edward Elgar.

Max-Neef, M.A. (2005). Commentary: Foundations of transdisciplinarity. *Ecological Economics, 53*, 5–16.

Moran, J. (2002). *Interdisciplinarity*. London: Routledge.

Nowotny, H., Scott, P. & Gibbons, M. (2001). *Re-thinking science: Knowledge and the public in an age of uncertainty*. Cambridge: Polity Press.

Platform FTeval 2003. *Evaluation standards in research and technology policy*. Vienna, Austria: Plattform Forschungs- und Rechnologie-evaluieung GesbR.

Rojo, J. (2002). Provision of R&D infrastructures. In G. Fahrenkrog, W. Polt, J. Rojo, A. Tübke, & K. Zinöcker (Eds.), *RTD evaluation toolbox: Assessing the socioeconomic impact of RTD policies* (pp. 32–48). EUR 20382. Seville, Spain: Joint Research Centre, Institute for Prospective Technological Studies.

Schummer, J. (2004). Multidisciplinarity, interdisciplinarity and patterns of research collaboration in nanoscience and nanotechnology. *Scientometrics, 59*(3), 425–465.

Scientific Council of the European Research Council. (2006). Retrieved June 1, 2007, from <http://europa.eu.int/erc/index_en.cfm?p=3_glossary>

Shapira, P., & Kuhlmann, S. (Eds.). (2003). *Learning from science and technology policy evaluation: Experiences from the United States and Europe*. Cheltenham, UK: E. Elgar.

Siune, K., & Kalpazidou Schmidt, E. (2003). The use of R&D evaluations in European science policy. In K. Siune & E. Kalpazidou Schmidt (Eds.), *The use of evaluations in Europe* (pp. 37–56). Report from the European RTD Evaluation Network meeting, Report 2003/2. Aarhus, Denmark: Danish Institute for Studies in Research and Research Policy.

Siune, K., Kalpazidou Schmidt, E., & Aagaard, K. (2005a). Background report to the five-year assessment: External five-year assessment of the implementation and achievements of the European Community and of the European Energy Community research activities (1999–2003). In *Implementation and management of the Framework Programmes* (pp. 375–384). Guilford, UK: European Commission, Directorate-General for Research, Directorate A — Coordination of Community Activities.

Siune, K., Kalpazidou Schmidt, E., & Aagaard, K. (2005b). Implementation of European research policy. *Science and Public Policy, 32*(5), special issue.

Tait, J., Williams, R., Bruce, A., Lyall, C., Grávalos, E., Rodriquez, P., et al. (2003). *Interdisciplinary integration in the Fifth Framework Programme (II-FP5)*. Final report, EC accompanying measure. Edinburgh, UK: SUPRA, University of Edinburgh.

Thompson Klein, J. (1990). *Interdisciplinarity: History, theory and practice*. Detroit, MI: Wayne State University Press.

Thompson Klein, J. (1993). Blurring, cracking, and crossing: Permeation and the fracturing of discipline. In E. Messer-Davidow, D.R. Shumway,

& D.J. Sylvan (Eds.), *Knowledges: Historical and critical studies in disciplinarity* (pp. 185–214). Charlottesville, VA: University Press of Virginia.

Thompson Klein, J. (1996). *Crossing boundaries: Knowledge, disciplinarities and interdisciplinarities*. Charlottesville, VA: University Press of Virginia.

Thompson Klein, J. (2004). Prospects for transdisciplinarity. *Futures, 36*(4), 515–526.

Weingart, P. (2000). Interdisciplinarity: The paradoxical discourse. In P. Weingart & N. Stehr (Eds.), *Practicing interdisciplinarity* (pp. 25–41). Toronto: University of Toronto Press.

Weingart, P., & Stehr, N. (Eds.). (2000). *Practicing interdisciplinarity*. Toronto: University of Toronto Press.

Ziman, J. (1994). *Prometheus bound: Science in a dynamic steady state*. Cambridge: Cambridge University Press.

Ziman, J. (2000). *Real science: What it is and what it means*. Cambridge: Cambridge University Press.

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