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The difficulties in assessing the impact of EU framework programmes

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Abstract

Evaluations concerning the EU framework programmes have not been able to get to grips with competitiveness, which is a major objective for these research programmes. The reasons include the general nature of the objective and the ensuing difficulty in measuring its attainment. There are also conceptual and methodological problems in evaluation studies, which arise from the fact that they are part of the political processes for formulating the programmes. The paper points out that the concept of additionality, used in these studies, has serious conceptual and measurement problems and asserts that in the evaluation of the impact of EU research programmes, too little attention has been paid to the interactions between firms' R&D strategies and their EU collaboration activities. The paper summarises findings of impact studies carried out in several countries and shows that intangible, infrastructural effects, such as learning new skills and catalysing new network relations, are the impact most often mentioned by all partners concerned. The programmes have other important effects related to the promotion of common standards, which are a prerequisite for the creation of a common market. In order to assess the longer-term importance and evolution of the networks created, more qualitative and longitudinal studies ought to be carried out.

Keywords: EU framework programme; R&D strategy; Competitiveness

1. Introduction

Few research programmes have been evaluated and studied as much as the Community framework programmes. Even so, the evaluations and studies have added fairly little to the general discussion on the contribution of the programmes to furthering the competitiveness of European industries, their prime objective. They have, however, pointed to a variety of ways in which the programmes have had an impact. In general, discussion of the impact of the programmes on competitiveness consists of sweeping statements which usually lament the unsatisfactory level of competitiveness of high tech industries in Europe, although they note a better situation in the telecommunications industries (see for example, Commission of the European Communities, 1992). They conclude that the programmes have not been successful in raising the level of competitiveness of European industries. There are a few exceptions to the general discussion, Pavitt's paper in this issue (Pavitt, 1998) being one of them. He questions the conclusion that information technologies industries in Europe are less competitive and paints a more refined picture.

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This paper will discuss the reasons why the evaluations and studies have not been able to directly address the broad question of the advancement of competitiveness by the programmes. It will point out two different types of reasons. The first concerns the general nature of the objective and the ensuing difficulty in evaluating its attainment. The second concerns problems in the evaluation studies themselves, and the fact that they are part of the political process which formulates these programmes, leading to less critical and internal evaluation. The paper will summarise findings obtained from evaluation studies concerning the role of the programmes. It will end by outlining new approaches for studying the effects of the EU framework programmes.

2. Evaluations and studies

The Commission has organised evaluations of specific research programmes, usually midway through, since the early 80s. Evaluation started on a test basis in the late 70s (Contzen et al., 1982). At the moment, these evaluations are called five-year evaluations and they do not pertain to particular framework programmes. The methods which have been used are not uniform, but the main method relies on outside expert panels. Evaluations provide the most recent, though somewhat fragmentary material on the framework programmes.

Member countries commissioned so-called impact studies of the first and second framework programme (see, e.g., Georghiou et al., 1993; Larédo, 1995; Reger and Kuhlmann, 1995; de Montgolfier and Husson, 1995). The studies concerning the second framework programme were carried out in a more or less concerted way and applied similar methodologies. New member countries have commissioned studies of the third framework programme (NUTEK, 1996; Ohler et al., 1997, and Luukkonen and Niskanen, 1998) and in Norway (Hagen et al., 1997) and Sweden, studies of the fourth framework programme have been carried out or are ongoing. All these studies have aimed at ascertaining the impact of the framework programmes on the countries concerned.

Within the MONITOR-SPEAR programme, the Commission has funded studies on various aspects of the framework programmes, [1] such as those on the management of collaboration in R&D programmes (Barker et al., 1995), effects on the co-operative behaviour of firms (Katsoulacos, 1994), a study of the impact of EC-funded R&D programmes on human resource development (Bosworth et al., 1994), and an economic evaluation of the effects of BRITE/EURAM programmes on European industry (Bach et al., 1995). There is also a study, not related to MONITOR-SPEAR, which concerns the RTD strategies of the largest companies in Europe and their participation in the framework programme and EUREKA (Lagrange et al., 1996).

All the above evaluations and studies have been commissioned by the authorities responsible for the R&D policies either at the European or national level. There also exist studies outside the policy context, studies which have been carried out by academic researchers on their own initiative, from different disciplinary points of view (e.g., Sharp, 1993, Peterson, 1991; Sandholz, 1992; Grande, 1996). In political science, such studies draw particular attention to the decision-making structures and to the influence of various actors on the process.

Aside from the five-year evaluations and a few other exceptions, the above studies are largely based on the experiences of the second framework programme. Exceptions include, for example, the study of the RTD strategies of large companies. Programmes evolve and change. Major industrial programmes of the fourth framework programme (e.g., BRITE-EURAM, ACTS) have created new and more varied conditions and practices within the programmes by emphasising vertical networks and market orientation. Policy conclusions based on the experience of the earlier programmes may not be valid under the new circumstances.

Another problem is that evaluations are based on unsystematic background information and many impact studies have weaknesses in their data collection, such as low response rates, small sample sizes and a lack of control groups with which to compare the findings (cf. de Montgolfier and Husson, 1995). The questions to be studied have been formulated within

[1] For a summary of a series of MONITOR-SPEAR studies, see Georghiou, 1994.

the framework defined by the authorities responsible for policies, and obviously, many of them have not been allocated enough resources to be carried out with proper attention given to methodologies. The evaluations have become part of the political process of legitimation of the policies adopted. The evaluation studies provide a large body of professional evaluators with commissions and obviously there are interdependencies between those commissioning the evaluation and those performing it (Luukkonen, 1997). This is related to the phenomenon of professionalisation of research policy evaluation, which means that in many European countries in the late 80s and early 90s, there has emerged a group of professional evaluators, consultants and evaluating institutions engaged in evaluation activities. The evaluators are dependent on those commissioning the evaluation studies for further projects and studies, and risk losing future clients if they voice strong criticism (cf. Luukkonen, 1997).

In spite of problems of principle and methodology, evaluation efforts and studies have provided some findings which are complementary in important respects. Still, their potential to contribute to our understanding of the impact of public intervention in the generation of new technologies or of the functioning of collaborative R&D networks has not been fully realised. Among other things, they have paid little attention to the interactions between firms' R&D strategies and their collaborative activities within EU research programmes. The fact that the studies have not looked at the collaborative networks or their functioning as units of assessment is also an important problem. The studies have resorted to standard survey methods addressed to individual participants, thus providing a fragmented view of how the collaborative networks function in practice. As will be seen further, networking emerges as a major impact of the programmes. More evaluation efforts should, therefore, be devoted to studying these networks.

3. The objectives of EU framework programmes

European Union research programmes have many objectives, some more general, some specific and related to the particular area of application. However, a general aim, as defined by the Single European Act, which was approved in 1986 and which gave a formal legal basis for Community action in supporting R&D, is ''to strengthen the scientific and technological bases of European industry and to encourage it to become more competitive at the international level.'' To achieve this goal, the Community ''shall encourage undertakings, including small and medium-sized undertakings, research centres and universities in their research and technological development activities'' (article 139f). This paragraph relates the support of research activities within the European Community to economic aims. The Maastricht Treaty, signed in 1992, added a statement which made Community policies, in all sectors covered by it, central to the objectives of Community research activities.

Perception of external threats and concern about Europe's economic—and political—survival have created a driving force strong enough to acquire sufficient political support for new initiatives in Community research policy. At the beginning of the 80s, these considerations led to the launching of major information technology (ESPRIT) and telecommunications (RACE) programmes, and in 1984 to the grouping of specific programmes under a broader umbrella, the framework programmes (Sharp and Shearman, 1987; Sandholz, 1992). Because concern about economic competitiveness has been a driving force in EU R&D policy, this paper will pay special attention to the evaluation of the achievement of this goal, even though, it recognises that, at the same time, the programmes have other goals. The promotion of general competitiveness in Community policy in R&D has been on uncertain ground, because the Treaty of Rome forbids the promotion of particular firms. The programmes have therefore an in-built paradox: while they are expected to promote competitiveness at a general level, they are not to promote particular firms. The promotion of precompetitive [2] and collaborative R&D networks has been

[2] Precompetitive research concerns research and development for which commercial possibilities remained five to ten years in the future. However, because of pressures from companies, during the fourth framework programme there has been a shift towards company-led consortia involving projects closer to the commercial utilisation.

an attempt to avoid the above inconsistency, and it is based on a model adopted from Japan, since the collaborative R&D networks of the Japanese MITI were perceived as successful in promoting industrial technological development (Sharp, 1993; Peterson, 1991; Sandholz, 1992; Sharp and Pavitt, 1993).

4. Why do the evaluations and studies not get to grips with competitiveness?

4.1. Different levels of analysis and the problem of attribution

Studies and evaluations have been carried out at the level of projects and research teams or at the level of firms and other participating organisations. It is obvious that such studies at the micro level cannot tell us much about the role of the programmes in advancing competitiveness in European industry in general. Even if all the projects funded were deemed successful, which is not and should not be the case —because studies whose outcomes are guaranteed are not worth funding—it does not follow that the overall competitiveness of European industries would increase. The European programmes are only a small percentage of all research activities funded by the governments in the Community countries (approximately 3.5%) and cannot be expected as such to achieve great impact.

Another problem with impact assessment is the problem of attribution, the fact that the EU R&D programmes usually concern one phase or part of a wider spectrum of activity or research portfolio, as noted by several authors (e.g., Metcalfe et al., 1992; Georghiou, 1994; Buisseret et al., 1995). It is true that there is accumulation and continuity in many networks. Organisations which collaborate with each other often do so in the next programme, too (Larédo, 1995). In spite of this, the Community projects have a specific, often relatively short duration and therefore a limited role in the process of the development and adoption of new technology within the firms. It is difficult therefore for an evaluator to separate the particular effects of these programmes from the effects of the R&D spending of the firms and other participating organisations or that of the national technology development programmes.

4.2. The concept of additionality

The evaluation needs of the programmes have prompted conceptual work on the concept and measurement of competitiveness. Metcalfe et al. (1992) emphasise that competitiveness is a relative concept and the competitiveness of a firm should be assessed in relation to the market position of other firms operating in the same area. Because the EU programmes have mainly operated in the pre-competitive area, and the time needed for commercialisation may be long, studies have aimed at discovering expectations for market opportunities. They have paid attention to the direct and indirect effects of the programmes on firm behaviour, that is, whether the programmes prompt behaviour which underpins the competitiveness of the firms in the long run. Examples of such behaviour include the propensity of firms to collaborate, changes in their project management skills, changes in the enhancement of human resources and in the transferring of knowledge within or between firms (Georghiou, 1994). These changes have been deemed to measure the difference which government sponsored programmes have made to the companies; that is, the *additionality* brought about by the programmes. The argument rests originally on the market failure rationale, that is, left to themselves firms will under-invest in innovative activities because of their inability to appropriate all the benefits arising from these activities (Metcalfe and Georghiou, 1997). Private appropriation of the results of collaborative R&D is rendered even more difficult because collaborative research entails additional costs compared with non-collaborative research, for newcomers in particular, partly because there are difficulties in preventing information leakages. Public subsidies are needed to overcome the reluctance of firms to be involved in collaborative R&D. As will be seen later on, conditions for collaborative networks funded by the EU framework programmes provide further obstacles for firms which want to embark upon collaborative R&D. We may therefore examine the extent to which the above assumptions of market failure are valid for assessing the EU research programmes.

Georghiou (1994) differentiated three different types of additionality. Input additionality was de-

fined as a situation in which the projects would not have taken place at all without the EU funding, behavioural additionality, as a situation in which the firm has done something in a way it would not have done without its participation in the project, and output additionality as a situation in which there are permanent changes in the behaviour of the firm.

Many studies (Reger and Kuhlmann, 1995, 54; Georghiou et al., 1993, 43; de Montgolfier and Husson, 1995; Lagrange et al., 1996) have pointed out that EU projects may enhance the scope, scale, and speed of a firm's own projects, constituting behavioural additionality in Georghiou's terminology, rather than prompt projects that would not have been embarked upon at all without EU funding. This holds in particular for large companies, for which, overall, funding per se is less important. A similar finding was obtained in a recent study of the impact of Japanese government sponsored R&D consortia (Sakakibara, 1997). The latter study wanted to go further and requested firms to make quantitative estimates of the effects of R&D consortia on private R&D investment and the acceleration of R&D. According to her study, without the publicly sponsored R&D consortia, private projects would have been conducted at approximately 34% of the scale of the actual ones and R&D consortia accelerated the R&D projects by three years (Sakakibara, 1997).

The above concept of additionality has been used with MONITOR-SPEAR studies to provide an analytical framework for evaluating the effects of EU programmes. A basic weakness of this approach is that it does not discriminate between the influences of R&D programmes in terms of importance for the strategies of the stakeholders. Additionality or change in behaviour does not provide enough evidence for drawing conclusions about the significance of the change in behaviour for the strategy of the participants nor about the importance of the potential new technology development in opening up new trajectories. It is, of course, a problem that when new initiatives are taken, even though there are expectations, their future importance and impact is not yet known. We may also ask whether it is desirable that government programmes prompt firms to embark upon projects they would not have done at all without public funding. Would such projects be important and strategic for the firms concerned?

The application of the concept of additionality to a study at project level is also a difficulty. Buisseret et al. (1995) drew the conclusion that attention should not be devoted to a particular project in isolation, but in the context of the overall R&D strategy pursued. Changes in the latter should be the focus. Impact studies which concentrate on the project level have not been able to tackle this aspect sufficiently. Still, even if the focus were on R&D strategy, it would not be easy to establish a link with the enhancement of competitiveness. According to the above-mentioned study of the Japanese R&D consortia, firms did not perceive collaborative projects to be critical for competitiveness nor was there a link between participation in collaborative projects and industry competitiveness based on statistical information about world export shares of industrial clusters (Sakakibara, 1997).

Methods which are more refined quantitatively do not solve the above problems. Numerical assessments such as those made in the above-mentioned Japanese study or in a study by the BETA group in Strasbourg on the commercial effects of projects in Brite-Euram programmes (Bach et al., 1995), as accurate as they seem, involve a large element of uncertainty and softness. The basic problem of attribution remains.

Instead of attempting to establish a connection between competitiveness and the collaborative R&D programme, more attention should be drawn to the way in which collaborative R&D has advanced, or is expected to advance, the objectives and R&D strategies of firms. This would mean that we would have to study further what underlies the notion of advancing the scope, scale or speed of projects and what is the importance of such projects for the firms. We need to follow what happens in collaborative networks to find out the outcomes of collaborative R&D, not only the expectations and intentions. A lot of research literature on R&D collaboration is more concerned with the reasons why companies get involved in collaborative R&D and less with their experiences of it. The reasons include objectives such as: a goal to achieve economies of scale, to search for new marketing opportunities, to accelerate the innovation process, to anticipate complementarities, or to utilise spill-overs of R&D within the consortium (Hagedoorn and Schakenraad, 1990;

Teece, 1992; Sakakibara, 1997; Lemola, 1997). Qualitative and longitudinal studies might provide us with better insights into what happens in and for the networks. Thus we could learn more about the fulfilment of the expectations.

5. Collaborative networks and intellectual property rights

In collaborative R&D firms have to weigh the costs and benefits of the spillover of the firm's R&D to other firms and to settle problems related to intellectual property rights. In EU consortia, the problem of intellectual property rights is especially pertinent, because the statutes require that all participants share the results obtained. Unlike the EUREKA programme, the framework programmes have clear rules in this respect and the participants have little leeway. Another difference between the programmes is that the EUREKA projects are much more market oriented and their financial arrangements are more diverse. Different programmes provide different circumstances for collaborative R&D.

The importance of intellectual property rights for participation in collaborative R&D programmes is illustrated by the report by Lagrange et al. (1996), which represented the views of the top 500 European industrial companies on the framework programmes and EUREKA. The report pointed out that problems with intellectual property rights were among the three most important obstacles preventing more substantial participation of firms in the framework programmes (Lagrange et al., 1996). The study of the impact of participation in EU framework programmes in Finland reported that problems concerning intellectual property rights were the most important problem in research collaboration for large companies (Luukkonen and Niskanen, 1998). Additionally, a need to prevent leakage of sensitive information is an important factor discouraging companies from participating in EU programmes, and if they do participate, it influences their choice of the area of collaboration. The same holds for consortia in which the companies are not working with their direct competitors. EU consortia are regarded as fairly open and companies cannot prevent the leakage of information and control the information flows between the participants as much as they would like.

In the Finnish impact study, consideration of knowledge spill-overs was important for firm strategies in their participation in EU framework programmes (Luukkonen and Niskanen, 1998). Firms in different industries were in dissimilar situations in this respect. The following section will summarise standpoints concerning intellectual property rights in EU research projects and the changing strategies for R&D collaboration adopted by firms in different sectors. It will illustrate that the role or potential utility of collaborative R&D programmes and that EU programmes should not be studied only in general terms. The firms and industries have diverse and changing competitive situations and varying needs for collaborative R&D. These factors influence the utility of the programmes for firms. They also influence the ways in which firms solve problems related to intellectual property rights.

According to the Finnish study (Luukkonen and Niskanen, 1998), *pharmaceutical companies* [3] had strong disincentives to collaborate in the Community programmes, such as the Biotech Programme, and do so to a lesser degree than could be expected considering their research intensity and wide collaboration with universities. They have very high R&D costs, spread over a number of years (often ten years) and have difficulties in gaining sufficient returns from R&D spent. In the fierce competition over market shares worldwide, firms are looking for niches and subsequently secrecy problems are great. The study pointed out that European pharmaceutical companies are not willing to collaborate with each other. They compete for different market segments and have different specialisations, which means that they have fewer common interests, or if they compete for the same market segments they are not at all interested

[3] A considerable structural change took place in the Finnish pharmaceuticals industry in the 1980s. At the beginning of the 80s 13 pharmaceutical companies were still operating in Finland while at present the domestic pharmaceutical International is concentrated around two companies, Orion, Pharma and Leiras Oy. The latter was recently bought by the German Schering and it has been predicted that the former will not stay in Finnish ownership very long.

in collaborating in R&D. If basic research reveals a possibility for a new therapy, research and development is moved over to the private sphere and for competitive reasons, there is no room for fairly open collaboration networks such as those within the EU programmes.

A change was taking place in the strategies of Finnish pharmaceutical companies during the fourth framework programme. One company was involved in research projects in information technology aiming at improving production processes. In heightened competition, the company felt compelled to pay more attention to the effectiveness of its production processes, a factor which earlier had played a less important role because the proportion of R&D costs to the overall costs are very high. The other major firm took the initiative to create a consortium with university researchers in order to acquire the most up-to-date knowledge in a rapidly developing new field, outside its core activities. This company thus perceived the EU consortium as an opportunity to create a broader network which it could not have otherwise afforded, and to attract the attention of top level scientists to issues of interest to the company.

By contrast, in the *telecommunications* area, Finnish companies are willing to collaborate with each other in the area of their core technology because of their vital interest in influencing standardisation (pre-normative research) and to advance the marketability of their products (Luukkonen and Niskanen, 1998; cf. Metcalfe and Georghiou, 1997). Competition in telecommunications has heightened, and has in some areas become a competition between different standards. Therefore, the firms have strong incentives to collaborate even with their rivals in order to influence the standards. Still, networks are preferably created along the value chain.

When, in the late 80s, Finnish companies got involved in EU framework programmes, the competitive situation in the field was not as heightened and the position of the Nokia Group, in particular, was not as important in international markets as it is today. In a similar vein, company strategies differed from what they are today. For example, the Nokia Group got involved in EU collaboration with more vague objectives regarding its internationalisation strategies and its wish to monitor development in other companies.

A third, quite different example is provided by Finnish *forest firms*.[4] This sector has low R&D intensity in general, though Finnish companies are technologically highly advanced in their field. In the second and third framework programmes Finnish forestry companies participated in EU research programmes only through their joint research institute and the projects were clearly in the pre-competitive area. The companies did not have a clear strategy for EU collaboration at the time. They got more interested in EU programmes during the fourth framework programme, partly because of an information campaign by their interest organisation. In spite of being more alert to the opportunities provided by the EU framework programmes, forest companies have difficulties in participating, because their own activities do not include basic research and their own projects are fairly developmental. Development projects were regarded as confidential because they were too close to the end product. The companies also thought that EU consortia are too open and that it was difficult to prevent information leakages to their competitors. Finnish forest companies are reluctant to embark upon collaboration with their direct competitors, because they regard themselves to be the world leaders in their core technology, and are afraid to disclose their own expertise to other forestry companies. They are, however, aware that the programmes provide opportunities for collaborative R&D in areas in which problems related to disclosure of knowledge are less likely, that is, in areas outside their core competence. There are new initiatives for collaboration with the chemical industry (plus public sector research institutions) to improve waste management, an area which, due to environmental concerns, has become an important competitive factor in the forestry industry. As a further indication of their changed strategy, they were actively involved in pressuring the Commission to gain visibility for forest research in the fifth framework programme.

In the above study (Luukkonen and Niskanen, 1998), companies in the same sector made different choices concerning EU collaboration, highlighting that managerial policies and decisions also played an

[4] After mergers in 1996, there are only three major forest companies in Finland: UPM-Kymmene, Enso and Metsä-Serla.

important role. Some companies regarded information leakages to be a more severe problem than did others. The examples highlight the diversity of circumstances in which firms decide to embark or not to embark upon collaborative R&D. This diversity is increased by the special conditions of the EU research programmes.

6. What we have learned about the role of the programmes

In spite of the programme variety and difficulties in studying the rationale and impact of the programmes, there is cumulative evidence obtained in many of the studies of the importance of EU framework programmes for firms, which can be summarised as follows.

6.1. Role for large firms

European Union programmes do not make much difference for RTD strategies of particularly large firms (Lagrange et al., 1996). These firms are able to carry out vitally important projects within their core technologies by themselves without public funding. EU programmes are taken into account when decisions are made on the means to implement RTD strategy at the project level, that is, in project decisions. EU funding provides a choice among potential sources of public funding. EU projects may, however, be important for the R&D departments of such companies as a source of funding and in helping them obtain internal support for the project. R&D departments have to convince the business departments of the company of the usefulness of the project to obtain internal support for projects for which commercial applications are still very uncertain. This factor can contribute to a failure of the project as well: if the company is not committed, the project may not obtain enough internal resources and the project objectives are not achieved.

At the company level, EU money does not play a decisive role for the companies especially taking into account that the application process incurs costs and a large proportion of the applications fail. Collaboration itself also causes costs in terms of money and the time of highly skilled personnel. EU bureaucracy causes additional costs in terms of project management and delays in project performance.

The EU programmes provide a legal framework for cross-country and cross-institutional collaborative agreements, which may encourage making them while, at the same time, introducing new difficulties for collaboration. It is to be noted that large companies have collaborative relationships with universities, research institutes, and other companies and use these for their RTD. Collaboration, even cross-country collaboration is not new to them. A major difference between their own and EU collaborative arrangements is that the latter usually involve a larger group of collaborative partners, more complicated constellations, and a fixed set of rules, all of which bring about additional problems of managing intellectual property rights. As stated above, EU rules require that the participants of a consortium share the results. Trust in partners is a decisive factor for collaboration to emerge. Trust is more difficult to create in a consortium consisting of partners all of whom were not previously well known to a given partner. The market failure argument in favour of public programmes in collaborative R&D may not hold for EU programmes, since they provide additional problems and thresholds for firm participation.

However, successful collaboration prompts further collaboration (e.g., Katsoulacos, 1994; Georghiou, 1994). Firms also find new partners through the EU networks. EU funding may act as a catalyst in the creation of new, emergent network configurations (see Callon, 1997).

Studies have drawn attention to new technology-based firms, such as those in software, which have changed their R&D strategies because of participating in EU projects. In order to sustain their competitive edge, thanks to the ESPRIT programme, they were prompted to perform their own R&D, which earlier was lacking (Georghiou, 1994, 30–31).

For some companies, EU programmes may provide a way to complement their competencies in non-core technology areas. According to a study of the largest European companies, this is especially true for companies in the less R&D intensive sectors (Lagrange et al., 1996). Examples of complementarities include the application of information technology to make production processes more effective (in

many industrial branches), or as referred to above, to utilise chemical R&D to improve waste management in forestry industry. In areas of technology new to the firm the EU framework may facilitate finding collaborative partners. In terms of knowledge spillovers they have more to gain and less to lose.

6.2. Role for SMEs

For small and medium-sized companies, EU funding is important per se, but SME's in general are less able to utilise and participate in EU projects. These companies usually cannot commit their funds for projects the commercial applications of which are in a time horizon of several years. They need commercial returns much earlier. There are exceptions, especially small R&D intensive firms, some of which may be R&D performing firms and may resemble R&D departments in larger companies. Sometimes it is not easy to draw the line between the R&D department of a large firm and a small firm which performs R&D. The latter may be mainly owned by a larger firm. For small firms EU research projects can be 'business as usual', an opportunity to sell their highly developed, tailor-made products to a group of sophisticated customers.

6.3. Learning to collaborate

Problems concerning intellectual property rights and preventing leakage of sensitive information are difficult and may be a hindrance for companies' participation in the Community programmes. However, while participating in the programmes, companies learn how to deal with these problems and learn the type of R&D for which the EU programmes are feasible and useful. A small study of the management of collaboration in successful projects indicated that it was possible to solve the problems related to intellectual property rights and that the successful participants did not perceive problems in this respect (Barker et al., 1995). The ability of the participants to solve these problems may have been one of the success factors of the projects.

Finnish firms are fairly new participants in European collaborative programmes; they have been able to participate since 1987, but have actively done so only during the fourth framework programme and Finland's full membership since 1995. They seem to perceive quite a lot of problems in terms of intellectual property rights. This may be because they are still at the beginning of their learning curve in utilising the opportunities provided by EU programmes. They are, however, learning fast and had changed their strategies by the beginning of the fourth framework programme. Clear company-to-company differences emerged in the choices made and how they learned to utilise the programmes. Earlier skills and capabilities in international R&D collaboration were important for utilising the opportunities provided by the EU research programmes.

Judging by the available evidence, one of the most important effects of the European programmes may be enhancing the position of particular firms, those which are quick learners and higher in their learning curve concerning EU collaboration. Thus the programmes do help particular firms rather than particular branches within European industry or European industry in general. This would mean that when promoting particular firms, the programmes function against the principles of Treaty of Rome. The promotion of vertical networks by some industrial programmes (e.g., BRITE-EURAM, ACTS) may encourage a further development towards the promotion of particular firms and private appropriation of the results.

6.4. Intangible effects

The consideration above showed that there is little concrete evidence of the promotion of the competitiveness of European industries in general. EU research programmes are used for a variety of purposes by companies, and as will be seen below, other research performing organisations. Even if they do not promote competitiveness, they have other important roles.

A major finding from studies of the EU research programmes (Reger and Kuhlmann, 1995; Georghiou et al., 1993; Møller and Kjeldsen, 1995) as well as from the above mentioned study of the Japanese R&D consortia (Sakakibara, 1997) is that intangible learning effects are the most often mentioned impact for all parties concerned. Participants emphasise the effect of learning new skills and enhancing knowl-

edge. Skills means both the technical/scientific skills or the social skills which are needed in collaboration, though according to the Finnish impact study, the former were much more important (Luukkonen and Niskanen, 1998). Skilled personnel are vitally important to firms for performing R&D and developing commercially successful products and one of the conditions which enhance the competitive position of European firms in the long run. However, it is an infrastructural matter the influence of which is difficult to directly link with the competitive performance of firms in the medium or short term.

The programmes have other intangible effects. They stimulate networks among universities, research institutions, and companies across national boundaries. One of the early and political motives for Community research programmes was the creation of a European scientific and technological community, as exemplified by the British Prime Minister Harold Wilson's proposal for a separate European Technological Community in 1967 (Aked and Gummett, 1976). The programmes may indeed work for this goal. Recent bibliometric findings indicate that the Nordic countries have increased their collaboration with the major EU countries in the 90s, the time period during which the Nordic countries became active in EU collaboration. [5] An earlier study by Narin and Whitlow (1990) on co-authored papers between EU member countries at the time, and based on SCI publications from 1977–85, indicated a slight increase in inter-EU collaboration at the level of all fields. These findings refer to a potential change in behaviour of research organisations that publish scientific papers. In a similar vein in Finland, interviews with leading medical scientists further suggested that in medicine the programmes have helped create more collaboration within Europe, and that the dominant position of the USA in collaboration has slightly weakened. We have no corresponding data on firms.

However, we have to take into account that an increase in international collaboration is a general trend. The European programmes may act as a catalyst and stimulate more inter-European collaboration. The above-mentioned bibliometric data on the Nordic countries further indicated that the increased inter-European collaboration did not take place at the cost of other international collaboration. There was a diversification of collaboration partners and an overall increase in collaborative relations.

The Finnish impact study highlighted that the companies and research organisations which participated in EU framework programmes had important collaborative partners outside Europe, in the USA in particular, but also in Japan, other Scandinavian countries, and a few other regions (Luukkonen and Niskanen, 1998). Technology directors of major Finnish companies reported that earlier international collaboration had created capabilities for collaboration within the EU and facilitated it. Likewise, the report concluded that EU collaboration was not a hindrance for other international collaboration. Quite the contrary. Enhanced skills in international collaboration learned from the EU projects would further facilitate future international collaboration efforts.

7. Concluding remarks

There is no direct evidence that the EU research and technology programmes would advance the competitiveness of European industries. Firstly, it is difficult to tackle the competitiveness of whole industries as advanced by public programmes. It is also difficult to link the participation in these programmes to the economic performance and success of the firms, for reasons related to attribution of effects and pre-competitiveness. Furthermore, the programmes provide an extremely modest portion of the overall R&D spending of the companies and we cannot expect them to exert much influence. Available studies have also indicated that they do not influence the R&D strategy of large firms. However, the programmes seem to have a role in the creation of platforms for negotiations on standards. These are an important prerequisite for the creation of a common market and a matter of great importance for company performance in world-wide competition. They also provide an opportunity to share the risks and costs of uncertainty in technological development, as is the case of public programmes in general.

[5] Private communication from Olle Persson, Inforsk, Sweden.

Another finding from the many studies is that EU research and technology programmes enhance the acquisition of new skills and knowledge, that is, the collective learning processes. These are intangible infrastructural effects. This finding holds true for both the impact studies of EU RTD programmes and the study of Japanese R&D consortia. Before drawing further conclusions, it should be remembered that both programme types have mainly been in the pre-competitive area. It is possible that the impact will vary with the change of the programmes towards user and market orientation.

Another important effect concerns the promotion of collaborative networks within Europe among new configurations of partners; it means that they help create a community of professionals sharing the same basis of knowledge and trusting each other. Time will show whether this will lead to long-standing changes in collaborative behaviour. The European programmes provide resources for inter-European collaboration at a time when international collaboration is increasing in general. The programmes may influence the direction of collaboration, but they also provide a catalyst for creating new configurations of collaborative networks and make researchers more alert to collaboration.

If learning new skills and the creation of networks constitute a major impact, further assessment efforts ought to be diverted to studying these aspects. This would imply longitudinal and micro-level studies of the evolution of the emerging networks to see the extent to which they are opportunistic and short-lived, and whether they stabilise at some point (Callon, 1997). We should not regard it as self-evident that networking is always, by definition, beneficial.

We should also promote evaluation studies which are independent, and carried out outside the political process. Studies of the impact of EU research programmes can add to our knowledge of the role of public initiatives, particularly of collaborative R&D programmes, in promoting new technologies; and of the diversity of circumstances under which firms decide about their policies concerning collaborative R&D programmes.

The observation that the impact of EU research programmes is on the promotion of infrastructural matters rather than on the promotion of competitiveness leads us to question whether expectations as to the role of the programmes as a promoter of competitiveness in European industries are not misplaced. Here we deal with issues related to the objectives of the programmes and not their evaluation per se. In pursuing the theme of what might be the most feasible objectives and what might be the most feasible tools for their attainment, we ought to promote discussion of the best ways to advance infrastructural matters, such as the skills and the training of personnel, functions in which the public sector has traditionally been active. Targeted research programmes may not be the best option in this respect. Rather, programmes which are more broadly defined, contain fewer targets with less detail, and those which apply bottom-up principles might better serve the objective of enhancing infrastructural matters.

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