Benchmarking Strategies and Methodologies of National, European and International R&D Programmes, to Assess and Increase Their Impact on Innovation

(ImpLore)

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EXECUTIVE SUMMARY

Background

At the Lisbon Summit in 2000, the European Council agreed to make Europe the most competitive knowledge-based economy in the world by 2010. **Improving the innovation performance** of Europe's enterprises is a prerequisite to meet this ambitious objective and to successfully compete in global markets. Subsequently, a large number of initiatives both at the EU and on the national and regional level have been put forward. Many of these focus on increasing the inputs of innovation, particularly the resources for conducting research and technological development (R&D). While R&D programmes are evidently an important method to increase public and private R&D activities, their impact on fostering successful innovation has been less explored. This report attempts to add insight on the latter.

In order to gain more insight on innovation impacts of R&D programmes, the European Commission, Enterprise and Industry Directorate-General, commissioned a study on "Analysing and Evaluating the Impact on Innovation of Publicly-funded Research Programmes" under which two separate reports have been produced. A first report on the "Evaluation of the Impact on Innovation of Projects of Community 5^{th} and 6^{th} RTD Framework Programmes" (InnoImpact, see www.innovationimpact.org) provides this document with methodological approaches to identify innovation impacts of R&D Programmes. The present report focuses on "Benchmarking Strategies and Methodologies of National, European and International R&D Programmes to Assess and Increase the Programmes' Impacts on Innovation" (ImpLore).

Analysing and Evaluating the Impact on Innovation of Publicly-Funded Research Programmes	
Lot 1 Evaluation of the impact on innovation of projects of Community 5th and 6th RTD Framework Programmes (**InnoImpact**)	→ *methodology on indicators and criteria to assess innovation impact* **Lot 2** Benchmarking strategies and methodologies of national, European and international R&D programmes, to assess and increase their impact on innovation (**ImpLore**)

Objective / Approach

The aim of the ImpLore project was to **assess ways of improving the innovation impact of R&D programmes** in Europe. There are basically two approaches to do this. A quantitative approach would rest on a statistical analysis of impacts of certain features of R&D programmes on the innovation performance of programme participants (direct effects) and other actors (indirect effects) while controlling for any other impacts that might influence innovation output. A qualitative approach would focus on the experiences of programme managers and beneficiaries with different programme features (such as volume/degree/type of funding, kinds of

R&D activities supported, attributes of the programme management, monitoring and evaluation practices etc.) and on how these supported or impeded the introduction of R&D results into new or improved products and production processes. Given the data constraints for conducting useful quantitative analyses, this study primarily follows the **qualitative approach**. In particular, the study aims at evaluating appropriate strategies, practices and methods to assess innovation impacts of R&D programmes and initiatives and identifying good practice.

Analyses The ImpLore study collected **data on 431 R&D programmes** in Europe, focusing on programmes designed, financed and run at the level of the member states as well as on R&D programmes from third countries including the United States and Japan. A **survey of 173 programme managers** helped to assess design, management and evaluation features of R&D programmes and the likely impact of these on innovation. A series of **29 country reports** analysed the role of innovation system characteristics on innovation impacts of R&D programmes. These reports served a **Delphi-type survey of country experts** on strategies and barriers to improve innovation impacts of R&D programmes. A detailed analysis of **46 evaluation studies** hint on different ways of assessing innovation impacts of R&D programmes and the driving factors behind these impacts. A total of **10 focus groups** which met in various European countries and comprised programme managers, industry representatives and experienced evaluators qualified initial findings and added further insights, particularly on **good practice**. The main findings of the ImpLore study were presented and discussed by more than 230 participants at a **conference** held in Berlin (Germany) from October 23rd to 24th 2007.

Concepts Assessing the impact of R&D programmes on innovation requires a clear understanding of "innovation". In this report, **innovation** denotes the introduction of new technology or new types of products and processes that result from R&D activities. This concept includes the diffusion of innovative ideas and technologies across an economy.

R&D programmes and initiatives comprise all public activities primarily intended to fund R&D activities performed at public or private organisations, though some programmes may cover other activities as well. Indirect public R&D support through tax incentives and similar instruments are not regarded as R&D programmes in this report.

Caveats Assessing the impact of R&D programmes on innovation, and identifying good practices in the design and management of R&D programmes that meet this objective is challenging. First, R&D programmes are primarily designed to **enable or increase R&D activities**. While innovation is most often a desired result of these programmes, it is always difficult to achieve more than one goal with one instrument. As programmes are designed and managed to meet their primary objectives, it may be complicated to clearly associate certain design and management features with (not directly intended) innovation impacts. Secondly, innovation outcome of R&D efforts is affected by many variables. The characteristics of a public programme from which a given R&D activity has received a certain level of support are only of some, often **rather limited significance**. Attributing the relative contribution of R&D programmes to innovation success is thus anything but easy.

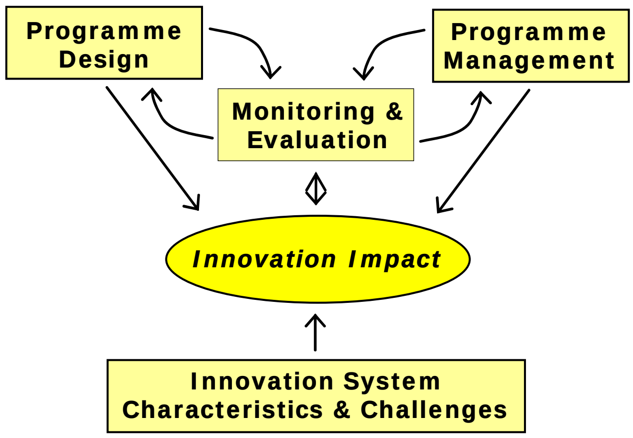
Having these limitations in mind, the report has gathered a number of generic findings on how policy makers and programme managers can assess their R&D policy activities with respect to increasing innovation impacts.

Results

Critical Policy Issues

Policies that aim at increasing the innovation impact of R&D programmes should consider four areas of activity:

- The **design of R&D programmes** in terms of rationales, target groups, thematic priorities, types of R&D activities supported, types of funding instruments applied;
- The **management of R&D programmes** in terms of project selection, communication with (potential) beneficiaries, influencing the design of project features, and accompanying project progress;
- The layout of programme **monitoring and evaluations** and the procedures to **learn** from the findings of these activities;
- The capacities and challenges of the **innovation system** within which a certain R&D programme operates, including the degree of policy intelligence to accurately identify innovation system characteristics and how to respond to current and upcoming challenges.



Programme Rationale

R&D programmes with a strong **innovation-related rationale** (i.e. explicitly tackling innovation challenges) compared to a strong research rationale are more likely to generate a positive innovation impact. There is an important qualification needed, however, since programmes which focus on **science-industry collaborations** are another way to achieve high innovation impact, though these programmes often focus more on fundamental research and address cooperation barriers rather than innovation outcome. Direct collaboration between public research and enterprises within a single R&D project tends to outperform other types of knowledge exchange between the two sectors. An important success factor is the **long-term commitment** of programmes that support science-industry linkages.

Programme Focus

Thematic programmes that support a specific technology can be regarded as having a rather high innovation impact compared to generic R&D programmes. Small programmes with **well defined objectives and target groups** are also likely to have higher innovation impacts, though these are typically limited to a very small fraction of the economy.

Demanding **private co-funding at the project level** is highly relevant for innovation impact, too. This result is intuitive since industrial partners who put in their own money are more likely to strive for commercial exploitation. R&D programmes that include the **mandatory dissemination** of project results to potential users or that have a deliberate strategy to directly **involve** (lead) **users** in R&D processes are also perceived as having a high innovation impact.

Selection Criteria

Striving for excellence has turned out to be crucial for programme success. Therefore, appropriate selection criteria for projects are important for the innovation impact of R&D programmes. Interestingly, selection rules which favour **scientific excellence** are more likely to generate a high innovation impact. One may read this as the need to generate new knowledge and open up new paths of technological development for successful innovation. Quite naturally, selecting projects based their **innovation potential** as well as on **excellence in transferring R&D results into application and commercialisation** also fosters the innovation impact.

Project Monitoring

Regular project monitoring is important to achieve some innovation impact. However, only a minority of R&D programme managers see a need for a comprehensive "innovation impact assessment". This portrays that **a direct innovation impact is not the main target of most of the R&D programmes in Europe.** Rather the role of R&D programmes is to build up capacities and capabilities that might induce innovations later or indirectly, and outside the control of R&D programme managers.

Involving Stakeholder

Involving stakeholders (e.g. representatives from industry or science associations) and (potential) beneficiaries of R&D programmes helps to orient programme design and management towards the **opportunities for research** in a particular field or market. Consultation exercises and workshops are the most common method of stakeholder involvement.

Limited Learning from Evaluations

The **majority of R&D programmes in Europe are evaluated**, mainly by the responsible ministry or a programme management agency. Surveys of beneficiaries and an analysis of the programme monitoring data are frequently used as methods of evaluation. The indicators used for evaluations focus on labour inputs, outputs, money spent, patents generated and the compliance of individual projects with programme objectives. Only a few programmes have been evaluated with respect to innovation impacts. Learning from evaluations to increase innovation impacts is impeded by a number of shortcomings, including unclear attribution of innovation impacts to programme activities, failure to identify project results fallacy and inadequacy in considering time lags between programme activities and likely innovation outcomes.

Bench-marking

When introducing or (re-)designing R&D programmes, **international benchmarking is used regularly**. Today, R&D programmes in most European countries as well as in the United States and Japan share a number of design, management and evaluation features. Hence, programme managers face quite similar problems, opening up the **opportunity for mutual learning**. The report identifies a selected number of good practices in evaluation studies and describes these cases in more detail.

Indirect Effects on Participants

Innovation-related **impacts of R&D programmes are primarily experienced by the beneficiaries of programmes**. While the key contribution of most R&D programmes is the enlargement of research capacities of participants, they also exert other innovation-relevant effects on participants. This "**behavioural additionality**" refers to, among others, increasing the participants' ability to interact and build networks, utilising science as a source of innovation, adapting innovation strategies and overcoming technological "lock-ins" or changing R&D and innovation management practices.

Country Diversity

The way R&D programmes affect innovation varies across countries. In the **new member states**, innovation impacts often relate to innovation infrastructures (technology parks, incubators, technology transfer offices) that are established in order to provide R&D performing firms an innovation-friendly environment and to foster commercialisation of research results from public science. The EU Structural Funds have played an important role for this policy priority. The design of many of these programmes benefited from international policy learning. In the **old member states**, particularly in those with a highly developed innovation system, most innovation impacts of R&D programmes emerge from programmes focusing on science-industry linkages.

Policy Conclusions

Generic Findings

Most policy makers would like to design and manage R&D programmes in a way that maximises innovation output. R&D and innovation activities are, however, highly risky by nature. Neither can the technological success of an R&D project be predicted in advance nor the market success of innovations that may result from R&D. Success factors of R&D and innovation vary a lot and are often unforeseeable. Thus there are no straightforward and easy to apply rules that could be implemented to any R&D programme which will automatically increase a programme's innovation impact.

Nevertheless, the report has produced some generic findings on how one could **benchmark** the potential innovation impact of an R&D programme as a starting point for further, in-depth analyses that have to consider the specific programme environment. The following design, management and evaluation characteristics tend to indicate a programme that is rather likely to produce a higher innovation impact:

- Programmes that support **linkages among actors** tend to have higher innovation impacts. Linking actors facilitates knowledge flows and mutual learning, can help to re-direct R&D activities towards promising thematic areas or to particular needs of potential users, and increases critical mass and diversity of the knowledge available to a certain R&D project. All these factors are likely to increase the productivity of R&D activities both in terms of generating useful results and shortening the time-to-market, and will tend towards improving innovation success. Linking actors need not necessarily rest on formal cooperation. Involving users in the definition stage of R&D projects or involving relevant innovation partners through advisory boards are other alternatives. Links can also be established through market-based transactions, for example, by purchasing technology or assigning contract research.

- **Collaborative R&D programmes** involving both science and industry organisations often prove to be more effective in terms of innovation output, particularly for path-breaking innovations. One has to bear in mind, however, that these innovations are also very risky, and project failure is also frequent. Industry-science collaboration seems to be an especially promising approach for countries with a highly developed and diversified innovation system.

- **Thematic programmes** and **small programmes** with well-defined objectives and target groups tend to show higher direct innovation impacts which may be attributed to specialised knowledge of the programme management which can focus on a specific field of technology or specific target groups and thus better know their capacities, needs and constraints.

- R&D programmes should include a **project monitoring** that registers project progress with respect to achieving R&D and innovation goals. Monitoring activities should involve as little costs as possible from the participant perspective and should be linked to ongoing evaluation or accompanying programme analysis. It should serve as a feedback mechanism and be used to adjust programme design features.

- R&D programmes should be subject to **impact evaluations** that assess the contribution of programme activities on innovation performance of beneficiaries. Since conducting such evaluations requires a certain amount of information on the funded projects and the programme participants, programmes should collect this information beforehand through application and monitoring procedures, while keeping in mind that the costs for participants should be kept as low as possible.

- R&D programmes should consider the results of monitoring and evaluation activities of other programmes, including the **experiences of other countries** when designing programme features.
- R&D programmes that **involve stakeholders** through consultation processes or advisory panels tend to show a better performance in terms of innovation impacts since stakeholders are most likely to be aware of upcoming trends and challenges to which a programme should respond in order to maximise the innovation outcome of R&D efforts. Strong stakeholder involvement can, however, have some shortcomings particularly if the stakeholder groups are not well balanced.

Limitations

However by just considering the design, management and evaluation characteristics listed above, will not automatically result in higher innovation impact of R&D programmes. There are clear limits to the extent to which R&D programmes can be oriented towards the production of direct innovation output. On the one hand, the primary task of R&D programmes is to overcome barriers to invest into R&D, resulting from knowledge spillovers, financial market failures to finance high-risk activities or technological uncertainty. On the other hand, innovation is primarily an entrepreneurial activity. Innovative ideas will be successful if they are positively evaluated by the market and the innovating enterprise is able to compete against innovative ideas of other companies. Entrepreneurial capabilities, including advanced marketing and sales strategies, are imperative for this. Since R&D programmes are not designed to develop or improve entrepreneurial attitudes of participants, their scope to directly affect innovation success of R&D activities remains very limited.

A survey of R&D programme managers and focus group discussion revealed that there is **no simple check-list** for benchmarking innovation impacts of R&D programmes. Each programme operates under a specific context which determines its goals and strategies, the design and management features and any potential impact on innovation.

A further limitation is the **lack of clear evidence from evaluations** about the programme features that are more likely to positively affect innovation outcome. Evaluations suffer from a lack of attributing programme characteristics to innovation performance of participants and a lack of information on other relevant variables that affect an enterprise's innovation record, such as the role of competition, demand and an enterprise's innovation, organisation and marketing capabilities. Innovation impact assessment is further complicated by the fact that innovation effects of R&D may occur only some time after finishing that R&D project.

Further Steps

The European Commission can contribute to improving innovation impacts of public R&D programmes in Europe through different ways:

- First, the Commission could take a significant step in **improving evaluation practices** with respect to identifying innovation impacts of public R&D funding. For the Community RTD Framework Programmes, adequate methods for assessing innovation impacts should be applied regularly, building upon the findings of the Inno-Impact project.

- Secondly, the Commission could initiate ways to better interlink individual R&D programmes to form **coherent sets of programmes** in critical areas which cover different moments of the innovation cycle. Individual programmes are often too small in scale and too narrowly designed to specific R&D barriers to impact innovation significantly. A set of programmes that is designed, managed and monitored collectively regarding their effect on innovation would promise to improve R&D programmes' innovation impacts. The Commission can work with country member governments to ensure the existence of a whole suite of programmes which companies access to bring a technology to fruition. Some of these programmes may be offered at the EU level, others at the member state level, others at the regional level.

- Thirdly, learning among R&D programme managers is crucial. The Commission could maintain and further develop **networking among R&D programme managers**. EU initiatives such as ERA-nets, TAFTIE and TrendChart already provide platforms for exchanging experiences and for meeting each other on a flexible base. These activities could be used to specifically take up the issue of innovation impacts from R&D programmes. In particular, links between R&D programmes, policies and policy makers on the one hand and innovation programmes, policies and policy makers on the other could be tightened

1 INTRODUCTION

- This report aims at assessing the impact of public R&D programmes and initiatives on innovation. It wants to contribute to the ongoing Lisbon process by shedding light on how to increase innovation output - and thereby strengthening an economy�
s competitiveness - of public support to private R&D.
- While R&D programmes primarily address barriers to private investment in R&D, the way a programme is designed, managed and evaluated may have different consequences on its direct and indirect impact to innovation. This report particularly focuses on the effect of the design, management and evaluation features of R&D programmes on the innovation output of activities funded through these programmes.
- The study adopts a systemic view of the innovation process in which learning and collaboration are crucial, and successful innovation heavily depends upon the economic and social environment under which R&D actors operate.
- The study applies both quantitative and qualitative methods, including a survey of programme managers, a meta-analysis of programme evaluations and a focus group approach.

Background and Objective

At the Lisbon Summit 2000, the European Council agreed to make Europe the most competitive knowledge-based economy worldwide by 2010. This requires continuous efforts both in terms of investment for producing new knowledge and the market results of this investment, i.e. successful innovation. The European Council acknowledged the crucial importance of expanding knowledge production capacities at its Barcelona Summit in 2002, setting a target of 3 percent R&D investment in GDP by 2010 as a key indicator for increasing Europe's competitiveness. Meeting the Lisbon and Barcelona targets will demand substantial additional public and private investment in R&D, and the effective transfer of this additional investment into innovation and competitiveness. Public support to private R&D can play an important role in this process. If designed and managed in the right way, public R&D programmes and initiatives can provide both stimuli for more private R&D investment and increase the innovation output of this investment. This report is about the ways in which this can be done. The key objective is to assess the role of design, management and evaluation characteristics of public R&D programmes and initiatives on the programme's direct and indirect impact on innovation.

This study relates to a number of other reports and initiatives at the EU level that aim at monitoring and advancing progress towards achieving the Lisbon and Barcelona objectives. It follows the recommendations of the Aho Group of independent experts lead by Mr. Esko Aho on R&D and innovation to accompany increasing investment in R&D by an increase in R&D productivity, i.e. the output of R&D efforts in terms of innovation and competitiveness and identifying how R&D programmes and initiatives can help in this respect (Aho Group 2006). For this purpose, one has to take into account the substantial variation of R&D programmes in Europe with respect to design features (e.g. objectives, eligibility criteria, selection processes), management procedures and evaluation requirements and practices. EU Commission initiatives such as EraWatch and Pro-Inno/TrendChart constantly show that R&D and innovation policies at the level of member states are anything but homogenous. National framework conditions such as policy traditions and national innovation system characteristics lead to differences in policy practices. Since these differences are likely to lead to different impacts on innovation, it is important to adequately consider them when drawing conclusions.

More directly, the report relates to a study on evaluating innovation impacts of projects of Community 5th and 6th RTD Framework Programmes (InnoImpact; see Polt et al. 2008) which was created parallel to this report. This study feeds the present report by offering criteria and indicators for assessing innovation impacts of R&D programmes as well as approaches to identify programmes with a particularly strong innovation impact.

The objectives of the present study can be summarised as follows:

- Identifying R&D programmes and initiatives at the level of member states and third countries that show a significant impact on innovation;
- Benchmarking methodologies used to assess the impact of R&D programmes and initiatives on innovation as well as strategies to increase this impact;
- Identifying good practice in the design, management and evaluation of R&D programmes and initiatives and how these practices could diffuse;
- Organising an international conference to present, validate and disseminate the key results of the study and to pave the way for further co-operation of the involved actors.

Understanding Public R&D Programmes

Public R&D programmes primarily aim at increasing R&D investment of public and private actors, such as universities, public research centres and enterprises. Public R&D funding has mostly been justified through market failure. Nelson (1959) and Arrow (1962) laid the foundation of the current economics of science. The main argument is that scientific knowledge has a public good character, i.e. one cannot exclude actors from consuming the results of R&D, and consuming R&D results by one actor does not prevent other actors from consuming the very same results (non-rivalry). Both characteristics prevent the producer of scientific knowledge from fully appropriating the returns from his investments in knowledge production. The benefits from advances in science and technology spill over to other actors (researchers, firms, consumers). As a consequence, the private sector invests less in scientific research that is needed for fully utilising the advances of science. Additional public investment is therefore needed to achieve a socially optimal level of research. Historically, public funding focused on so-called "basic research", i.e. R&D that is characterised by particularly high spillovers. By funding the production of scientific knowledge, the economy will get new knowledge inputs that can be freely used by all other actors to develop specific new technologies and by doing so, increase productivity and wealth. The underlying assumption of this type of public support is that the transfer of scientific knowledge resembles a linear path. The conventional "linear model" assumes that basic research leads to applied research and technological development; new technology spurs production and productivity (see Kline and Rosenberg 1986). Although the linear model is frequently dismissed for neglecting important feedback loops between users and developers of new technology and the scientific base, it is still frequently used (at least implicitly) in science and technology policy.

Over time, further market failure arguments have been brought forward to justify public funding of R&D, leading to a further differentiation of public intervention. First, uncertainty over R&D output complicates external funding of R&D as the probability distribution of success of R&D projects cannot be determined a priori. Secondly, R&D is often subject to factor indivisibilities as certain R&D investment can only be undertaken on a minimum scale (for example, the need for very large research infrastructures such as particle accelerators) which may go beyond the financing resources of an individual business organisation. Factor indivisibility along with fixed cost characteristics of R&D can also be a major barrier for small enterprises to invest into R&D. Thirdly, achieving useful R&D results sometimes spans long periods and this may go beyond investment horizons of private actors. Fourthly, information asymmetries between R&D performers and potential external capital providers (such as banks) over the R&D performers' capabilities and the prospects of an R&D project impede external financing and may call for public funding mechanisms. Finally, public funding of R&D will be imperative whenever research for providing public services such as defence, health or education is required.

These traditional economic rationales for public support of R&D have, more recently, been supplemented by newer approaches from evolutionary and institutional economics, the theory of complexity, and the study of innovation systems. Evolutionary and institutional approaches stress the role of system failures due to technological and systemic complexity involved in scientific and technological advancements and their application in new products and processes that respond to user needs. Briand Arthur (1994) and Paul David (1985) argue that the economies of scale realized by firms that are the first to introduce a new technology may result in a "lock-in" of the initial technological trajectory, even though an alternative path of technological developments might turn out to be more efficient. It will thus be the role of public R&D funding to open up to these alternative paths. A second line of argument emphasises institutional constraints for applying and diffusing new knowledge. With regard to this, effective institutional arrangements for the transfer of knowledge and technology such as adequate incentives and facilitating intermediaries are crucial in order to fully leverage the benefits of R&D investment. The theory of innovation systems (Nelson 1993, Lundvall 1990) stresses the role of feedback loops between various stages in the R&D and innovation process. Interaction and collaboration between different actors fosters the transfer of R&D into innovations and should thus be supported by public R&D programmes. A further strand of argument underlines that the system of knowledge production, distribution and use, and the policies that regulate this system, has to be balanced. Missing elements may impair the systems effectiveness, thus policies should complement missing links and avoid coordination and institutional failures that may occur. This role of the government is also related to securing adequate investment in human capital.

The current practice of public R&D programmes and initiatives combine the various arguments for government intervention. As a consequence, R&D programmes tend to follow diverging objectives, resulting in different design features and management approaches. Nevertheless, there is still one principle common to almost all R&D programmes in place that is input additionality. At the end of the day, an R&D programme should produce a higher level of R&D investment than in the absence of the programme, either at the side of beneficiaries (direct input additionality) or at the side of third parties (indirect input additionality). In the absence of input additionality, public expenditure could be considered as simply substituting private sector expenditure (so-called dead-weight loss; see Hall 2008). Additionality could also be jeopardised in case public funding increases the price of scarce R&D inputs and thus displaces R&D activities of non-funded actors.

Output additionality, i.e. the additional private and social returns generated by public R&D programmes in terms of upgrading the set of products and processes in place by more innovative ones and thus increasing productivity and wealth, is another goal of R&D programmes, though it is much more difficult to measure than input additionality. What is more, a programme's capacity to directly affect output additionality is quite restricted since output additionality depends on activities of actors outside the group of programme beneficiaries, such as competitors and technology users. A related concept that has gained increasing attention among R&D programmes is behavioural additionality (see OECD 2006). This concept refers to the effects of a programme in terms of changing the behaviour of programme participants towards a certain desired behaviour, for example, entering networks with other actors, overcoming technological "lock-ins" or changing management or competition practices.

Achieving both input and output/behavioural additionality through a single R&D programme is challenging. It is well known from policy research that one policy instrument is typically able to address only one policy goal effectively. Addressing several goals is likely to lead to either programme inefficiency (i.e. a large effort both in terms of public money and policy management is needed to meet the goals) or programme ineffectiveness (i.e. not all goals can be attained). While analysing innovation impacts of programmes whose primary intention is to raise R&D investment a potential trade-off between different programme goals will have to be taken into account.

Understanding the Innovation Process

This report focuses on output additionality of R&D programmes, particularly emphasising on a programme's role in fostering innovation. Innovation is defined as new products (incl. services), new processes, new organisation methods and new ways of marketing which have been successfully introduced by enterprises in the market place (with respect to product and marketing innovations) or within the organisation (with respect to process and organisational innovations) (see OECD and Eurostat 2005). Innovation generally alters an enterprise's competitive position. Through increasing product quality and process efficiency, innovations contribute to wealth, particularly when innovations diffuse widely and rapidly within an economy.

In order to assess innovation impacts, one needs a proper understanding of the innovation process and the factors driving innovation success. Innovation research has made significant progress in conceptualising and explaining innovation output of individual actors and an economy as a whole. Today, innovation is seen as the outcome of a complex process directly or indirectly involving a number of different actors that together form a so-called innovation system (see Edquist 1997, Etzkowitz and Leydesdorff 2000, Fagerberg 1995). R&D is only one, though highly important, ingredient to successful innovation. Interaction between different actors (enterprises, public research organisations, government agencies, consumers) is equally important as is the functioning of product and factor markets, the existence of facilitating institutions (such as intellectual property regimes), and social rules and traditions.

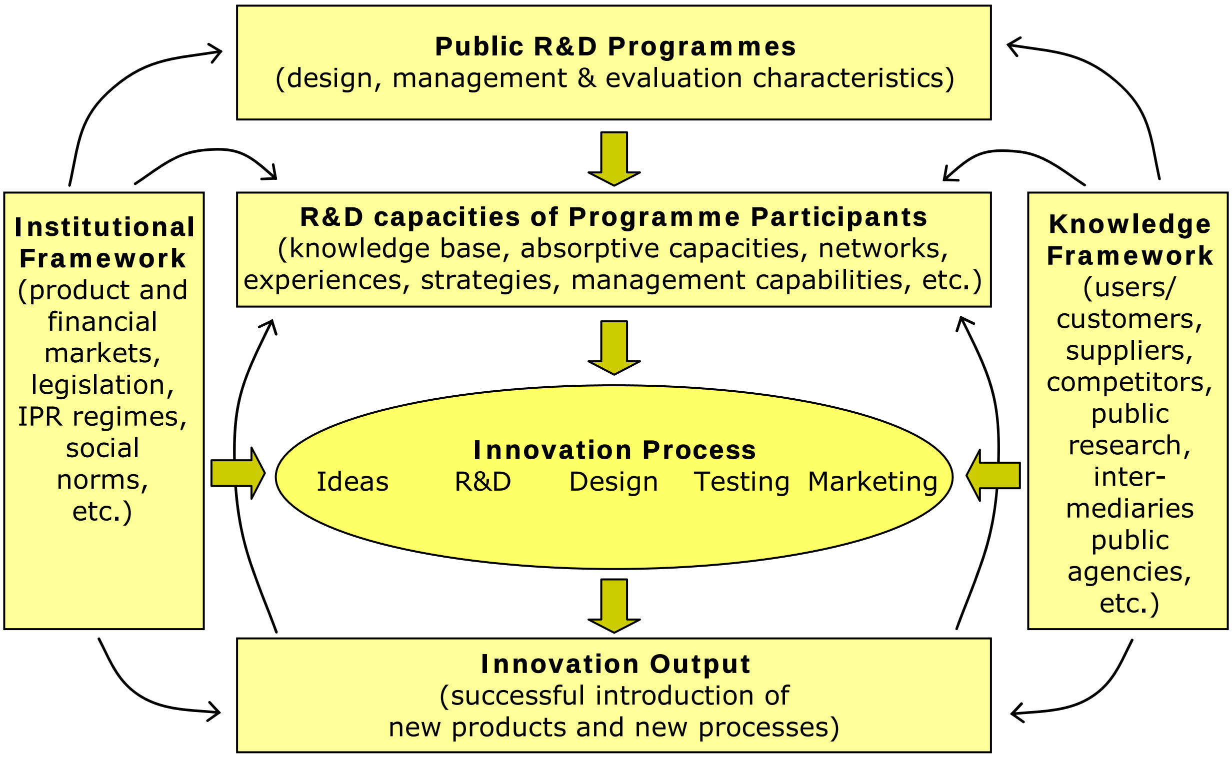
Following Kline and Rosenberg (1986), we apply a systemic view of the innovation process which is represented by the chain-link model of innovation:

- Innovation is a non-sequential process which involves many interactions and feedbacks along a set of closely interrelated stages, including idea generation, R&D, design, testing and marketing.
- Innovation is a learning process involving multiple inputs from different sources.
- The inventive process - the production of new knowledge which is closely related to conducting R&D - is stimulated by various types of inputs and often serves as a problem-solving stage within ongoing innovation processes.

While these three features of the innovation process are rather common across sectors and fields of technology, the actual layout of innovation activities (for example, the sources of knowledge used to guide innovative efforts, or the number and frequency of links among various stages of the innovation process) still strongly depends on the market and technology environment as well as an enterprise's own resources, including its ability to absorb external knowledge and learn from others (so-called "absorptive capacity").

For identifying innovation impacts of R&D programmes, the systemic view of innovation implies that programmes should take the wider innovation environment into account and the specific layout of innovation processes. Figure 1 illustrates the main links between R&D programmes, innovation processes and innovation output in a simplified way. The important message from the graph is the role of linkages - both within the innovating enterprise and with its market and knowledge environment - for successful innovation. R&D programmes will have to (directly or indirectly) target these linkages if they want to actively produce positive innovation impacts. Linkages include direct interaction and collaboration with various private and public actors such as users/customers, suppliers, competitors, public research organisations, financial intermediaries, knowledge intermediaries, public authorities as well as access to highly skilled labour. Another important message is that innovation processes and success depends on the institutional and social framework, both in terms of markets, legislation and cultural norms.

Figure 1: The Link between Public R&D Programmes and Innovation



Source: ImpLore

While the primary role of public R&D programmes is to provide R&D actors with additional resources to conduct R&D, programmes have various possibilities to address the role of linkages and framework conditions through programme design and management features. Design features include the type of activity being eligible for funding, the type of financial instruments applied for funding, the way funding is delivered, the groups of actors being targeted (and the type of interaction required among different groups of actors), the scale and scope of R&D projects being eligible for funding, stages of the innovation process other than R&D being addressed, and the flexibility to adjust design features over time among others. Management features refer to the process of evaluating and selecting R&D projects, monitoring of funded projects, evaluation methods applied to assess the progress and output of a programme, and the way of incorporating experiences from other programmes as well as changes in the environment relevant to the programme.

Identifying Innovation Impacts

Identifying innovation impacts of R&D programmes is a challenging task. Though a large number of evaluation studies on R&D programmes have been carried out on regional, national and EU levels in the past, assessing a programme’s impact on wider policy goals such as innovation has turned out to be extremely difficult. The report by the European Court of Auditors (2007) on evaluation methods and practices in Community RTD Framework Programmes has identified five main methodological difficulties in measuring the impact and results of public intervention in R&D:

- Attribution problems;

- Measurement problems;
- Timing problems
- Project fallacy;
- Credibility, integrity and independence.

The attribution problem is related to the fact that the innovation output of a programme participant can be affected by a large number of factors, the programme being only one of them. Adequately capturing these other factors is extremely difficult both in conceptual and empirical terms. When it comes to innovation impacts on actors other than programme participants, the attribution problem tends to multiply. Evaluators also face a number of severe problems related to measurement. Innovation output is a multidimensional phenomenon which needs a set of indicators to measure it, many of which have to be defined specifically for the industry or field of technology considered. Availability of such data is, however, frequently limited. Furthermore, it is difficult to model causal relationships between R&D inputs and innovation outputs since R&D and innovation processes differ considerably. The comparability of results between different fields of science and technology is also limited. Simple innovation indicators (for example, the share of sales generated with new products) often turn out to be inadequate. The timing problem concerns the time lag between the period of conducting publicly funded R&D and the period when innovation output becomes effective. Since this time lag can be considerable, measuring innovation output too close to the finalisation of an R&D programme is likely to overlook important long-term innovation impacts. "Project fallacy" refers to the fact that the results of a particular R&D projects often rests on the results of previous R&D efforts. It is thus difficult to separate the impacts of a particular R&D project on innovation output from the impacts of other R&D activities. Finally, evaluators frequently face the problem of credibility, integrity and independence. They should be objective towards those who are being evaluated. However since the evaluators should have knowledge and specific expertise to judge the activities being funded and the outcomes, they are often part of a (social) network of actors which also include the researchers being evaluated. There is thus a trade-off between an evaluator's expertise on the one hand, and his independence and objectivity on the other.

Shortcomings in the design and management of R&D programmes can also limit the impact assessment in evaluations (see European Court of Auditors 2007). R&D programmes often lack explicit logic on how public intervention should contribute to innovation outcome. Another drawback is poorly defined programme objectives and weak performance measures implemented in programme monitoring. Furthermore, programmes need to implement a comprehensive evaluation strategy from the beginning in order to allow for meaningful impact assessment at a later stage. The timing of evaluations is another important issue. Many programmes tend to be evaluated very close to the end of the programme, limiting any conclusions about long-term impacts of the programme.

As a consequence of these limitations to innovation impact assessment, there are only few, if any, clear conclusions from existing evaluation studies on the link between programme design and management on the one hand, and innovation impacts of a programme on the other, which restricts learning from past evaluation practices on how to increase a programme's innovation impact. Against this background, the present report adopts a multilevel approach to identify R&D programmes with a significant impact on innovation and to benchmark the methodologies used to asses these impacts and finally to derive conclusions on how to improve innovation impacts of R&D programmes:

- Findings from the InnoImpact study on innovation impacts of Community RTD Framework Programmes are exploited both in terms of indicators and methods that can be used to detect innovation impacts of R&D programmes, and conclusions on the design and management features of RTD Framework programmes that help to generate a higher innovation impact of funded R&D projects.

- A group of national experts produced a set of 36 country reports that gather information on wider factors that influence the design, management and evaluation of R&D programmes, summarising the national characteristics and trends that might affect an R&D programme's innovation impacts. A Delphi survey of national experts was used to identify generic strategies and barriers in each individual country that affect the impact on innovation of R&D programmes.

- An analysis of the design and management features of a total of 431 R&D programmes on the national level -both within the EU and in third countries- provides information about programme design elements that may be relevant for increasing innovative output.

- An analysis of 46 evaluation reports on R&D programmes from 17 different countries provided insights on the potential of evaluations to inform programme managers about programme characteristics that may drive innovation output.

- A survey of 173 R&D programme managers provided information about their experience on generating innovation impacts through the programmes they are responsible for.

- A focus group approach is used to discuss hypotheses on R&D programmes' likely innovation impacts that have been derived from the above mentioned analytical activities and validate them against the experts' experiences. Focus groups were held in 10 different countries. They also helped to identify good practice in these countries.

The findings and conclusions from these interlinked approaches are used to derive principles and approaches for identifying innovation impacts of R&D programmes and good practice examples.

The methodology of the ImpLore study is discussed in more detail in Section 2.

Project Team

This report was produced by a consortium consisting of eight organisations from six countries:

- Centre for European Economic Research (ZEW), Germany
- Joanneum Research, Austria
- Maastricht Economic Research Institute on Innovation and Technology (MERIT), The Netherlands

- Management Science Laboratory (MSL), Athens University of Economics and Business, Greece
- Optimat Ltd., United Kingdom
- VDI/VDE Innovation + Technik GmbH, Germany
- World Economy Research Institute, Poland
- Wise Guys Ltd., United Kingdom

The consortium was led by ZEW. A High-Level Advisory Panel provided external advice and validated the approaches adopted by this study. Both groups provided highly valuable inputs.

One main input to the final report was provided by the participants of a conference organised within the project. This conference - "Turning knowledge into practice: Getting more out of public investment in innovation" - was held in Berlin on October 23rd and 24th 2007. More than 230 participants from programme management agencies, ministries, academia and industries across Europe, Japan and the United States discussed issues of how R&D programmes could be designed, managed and evaluated in order to maximise their innovation impact.

Structure of the Report

This report presents the main results of the study. Chapter 2 presents the methodological approach. Chapter 3 discusses the role of R&D programmes for stimulating innovation. Innovation impact of a certain programme is assumed to depend strongly on the programme's design and management features. The chapter includes results of a comprehensive analysis of R&D programmes and initiatives in Europe and elsewhere on programme features and their links to innovation. The role of R&D programmes is also put into a wider perspective of public strategies to stimulate innovation which tend to depend upon the development of a nation's innovation system. Since this is particularly relevant to the New Member States, the link between R&D programmes and innovation impacts for this group of countries is discussed in more detail in a separate sub-chapter.

The main results of the analysis on how R&D programmes can contribute to innovation outputs are presented in chapter 4. This chapter comprises three parts: lessons learned from evaluation studies, findings from a survey of programme managers, and conclusions from the focus group. Chapter 5 summarises potential strategies to increase innovation impacts of R&D programmes and how programme design and management features can be evaluated with respect to their likely contribution to a programme's innovation impact. Policy implications and recommendations conclude this chapter.

2 METHODOLOGY

The ImpLore study employs a variety of data sources and analytical approaches:

- A programme database was established that contained information on 431 R&D programmes in EU Member States and third countries. The database is used to classify and map design, management and evaluation features of programmes with respect to their potential innovation impact.
- 36 country reports were produced describing the set of R&D programmes and initiatives in those countries, assessing their role for innovation, and providing contextual information as well as good practice examples.
- A Delphi survey of country experts informs about prevalence and perceived impact of strategies and barriers to improving innovation impacts of R&D programmes.
- A survey of programme managers collected information on innovation impacts of R&D programmes and how these impacts relate to the design, management and evaluation features of programmes.
- Evaluation studies of R&D programmes were screened for ways to assess innovation impacts and for identifying driving factors for strong innovation impacts.
- Focus groups in ten countries provided detailed qualitative information about country and programme characteristics and the relation to innovation impact.

Results from the InnoImpact study were used at various stages of this study, including for the design of surveys and the mapping of R&D programmes with respect to innovation impacts. A High-Level Advisory Panel accompanied and guided the work. A conference with more than 230 participants discussed and validated the project findings.

The aim of this report is to assess ways of how the innovation impact of R&D programmes can be improved, particularly with respect to the role of design, management and evaluation features of programmes. Good practice examples should show how programmes can identify and improve their innovation impacts. There are basically two approaches to do this. A quantitative approach would rest on the statistical analysis of impacts of certain features of R&D programmes on the innovation performance of programme participants (direct effects) and other actors (indirect effects) while controlling for any other impacts that might influence innovation output. From these results one can derive conclusions on which programme features tend to be more successful in generating high innovation success while controlling for contextual factors and external effects. While this approach would certainly provide extremely valuable and robust information if performed in an appropriate way it is not feasible in practice owing to its huge data requirements. Identifying innovation impacts of a certain R&D programme would need to also consider various other influencing variables that are likely to affect the transfer of new knowledge into commercial products and processes. As time lags between R&D activities and resulting innovations can be rather long, analyses could span over long period of times, particularly if indirect effects are also covered.

A more feasible though challenging way is to follow a qualitative approach, which is done in this study. This approach rests on the experiences of programme managers and beneficiaries with different programme features (such as volume/degree/type of funding, kinds of R&D activities supported, attributes of the programme management, monitoring and evaluation practices etc.) and how these supported or impeded the transfer of R&D results into successfully introduced new products or new processes. Experience from these actors can be gathered through surveys, interviews, case studies, expert panels and various types of programme information, including evaluations. All these sources have been utilised in this study.

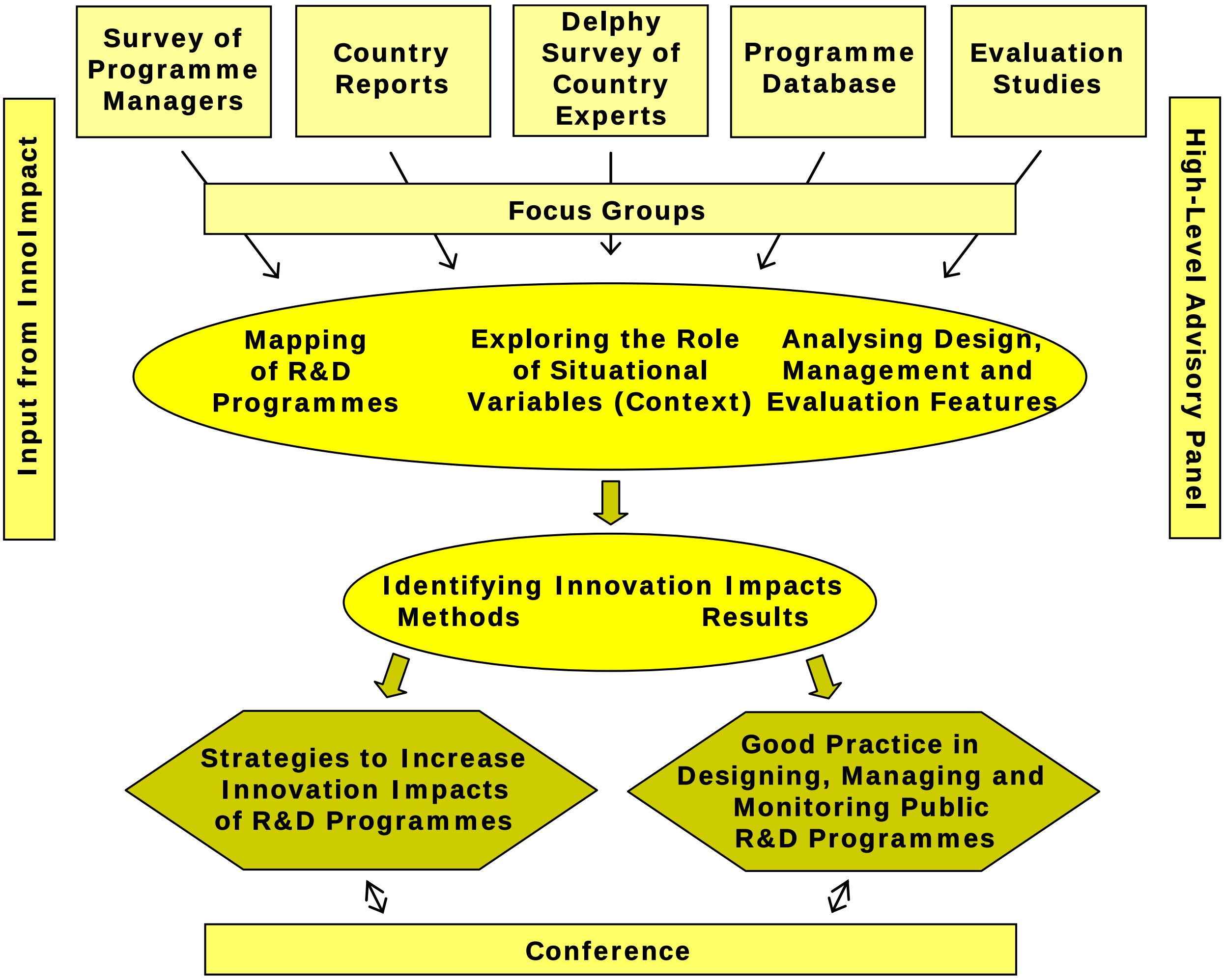
Methodological approach

The methodological approach of the ImpLore study rests on four pillars:

- A comprehensive data collection including a survey of programme managers, a series of country case studies, a Delphy survey of country experts, a programme database, a screening of evaluation studies and a focus group approach;
- Analysis of these information sources in terms of mapping R&D programmes, exploring the role of situational variables under which R&D programmes operate, analysing design, management and monitoring features of programmes, and identifying actual innovation impacts of R&D programmes, including methods to assess a programme’s likely innovation impact;
- drawing policy conclusions from these analysis with regard to strategies that can help to increase innovation impacts of R&D programmes as well as good practice examples for designing, managing and monitoring programmes in a way to fully exploit their potential innovation impacts;
- Utilising external expert knowledge through establishing close links to the InnoImpact study and involving senior experts in a High-Level Advisory Panel, and discussing and reflecting key results within an international conference.

Figure 2 shows the key elements of the methodological approach of the ImpLore study. See also Appendix 1 for the methodology paper.

Figure 2: Methodological approach



Source: ImpLore

Database of R&D Programmes

In order to analyse design and management features of R&D programmes and map them with respect to their potential innovation impact, a database of R&D programmes was established. For each R&D programme, the database contains variables that describe:

- the design and management of the programme;
- the monitoring, evaluation and impact assessment procedures applied within the programme;
- the observed or expected innovation impacts of the programme.

The variables were selected and defined based on preliminary results from the InnoImpact study. In a multistage process, variables have been tested, revised and refined.

The database covers 431 public R&D programmes. The majority of programmes are run by EU Member States on a national or regional level. The database also includes a selected number of R&D programmes from third countries, particularly the USA and Japan. Programmes were selected based on prior information of their likely impact on innovation in order to consider all R&D programmes that are relevant for advancing innovation.

All R&D programmes that have been included in the database are characterised by a focus on funding of R&D activities, on whether there are private or public actors and a pre-defined duration, budget, target groups and target activities. This means that block grants to universities, permanent institutional subsidies, general R&D subsidies (such as R&D tax incentives), and programmes with a primary activity outside the R&D domain (for example, Structural Funds programmes or regional programmes) were not included. The focus is on R&D programmes and initiatives on the national level. The database primarily covers ongoing R&D programmes, but also includes some programmes that were completed within the last five years.

Data has been collected by different means. For most programmes, responsible ministries or programme management agencies provide public information on objectives, funding principles, target groups, targeted activities, eligibility criteria and selection processes. Programme evaluations were another valuable source of information. Interviews with programme managers (both personal and telephone interviews) served to add more tacit information concerning programme management and likely innovation impacts. . See Appendix 3 for more information.

Country Reports and Survey of Country Experts

A group of country experts produced country reports for 36 countries that were covered in this study (EU Member States plus Australia, Israel, Iceland, New Zealand, Canada, USA, Japan, Switzerland, Norway). Based on a pre-defined template and a set of guiding questions, the country experts gathered information on R&D programme characteristics, a country's innovation performance, and a likely link between the two. The country reports summarise national characteristics and trends in R&D, innovation and policy making. This includes an analysis of general characteristics of how public R&D programmes are set up, implemented and monitored. Particular attention is paid to the way the national policy making deals with the issue of innovation impacts of R&D programmes and which factors are likely to facilitate or impede such impacts. National innovation performance data was used as a tool to investigate potential policy and programme drivers behind innovation performance.

A particular role of the country reports for this study was to analyse design features, tools and methodologies of R&D programmes which can have a significant impact on innovation. Based on expert assessments, evaluation experience and policy debates within each country, R&D policy measures, instruments and strategies with a significant innovation impact were identified ("good practices") and analysed in terms of approaches used to strengthen innovation output. This analysis produced a large number of factors which were then prioritised to represent the most prevalent generic strategies and also the barriers that have a repressing effect on innovation impacts. Based on these findings, country experts were asked to rank a shortlisted version of the most common generic strategies and barriers in order of their relative prevalence in that country and to what extent they had an influence on the impact on innovation of R&D programmes. Since this survey rests on the results of a first response by country experts and re-assesses the initial findings generated from the first response, one may regard this approach as a Delphi survey. See Appendix 4 for more information.

Review of Evaluation Reports

There are a number of reviews, evaluations and monitoring reports available for national R&D programmes and initiatives that inform about the relevance, effectiveness, efficiency and impacts of these programmes. Evaluation reports on R&D programmes contained in the programme database were screened, covering a total of 46 evaluation studies from 17 different countries. A main objective of the analysis was to identify the approaches currently used to identify programme impacts and to what extent evaluations could help to improve innovation impacts of R&D programmes. See also Appendix 2 with regard to the compendium of methodologies.

As it turned out almost all evaluation studies contain little if any information on innovation impacts and factors that drive innovation results of R&D programmes. Thus alternative methods and indicators have been employed: a survey of R&D programme managers and a series of focus groups.

Survey of Programme Managers

One potential entry point to assessing the role of programme design and management features on innovation outcome would be to ask programme participants (in particular enterprises that received funding through a public R&D programme) about their experiences with the programme and the innovation results achieved. This approach was applied by the InnoImpact study of the innovation impacts of EU RTD Framework Programmes. However because of cost and time restrictions as well as a lack of data on participants of national R&D programmes it was not feasible to follow this procedure for this study. Instead, a survey of R&D programme managers was performed. The survey was targeted at all programmes for which data has been collected in the programme database and comprised of three parts. The first part focused on an assessment of innovation impacts of the programme, the application of the innovation impact categories developed in the InnoImpact study[1] and the exploration of the range and scale of these impacts. The second part of the questionnaire tackled the relationship between design and management variables and innovation impact. The final part of the questionnaire asked specific questions about the strategies adopted by individual programme managers or administrations to both assess and improve innovation impacts. A total of 173 programme managers replied. Results from this survey were linked to the information on programme characteristics. See Appendix 5 for more information.

Focus Groups

The method of focus groups is a well established method in social sciences. Focus groups are expert panels that jointly discuss issues of common interest and background in a structured way supervised by an independent chairman. For the ImpLore study, focus groups include programme managers, policy analysts, policy makers and representatives from stakeholders and programme target groups (e.g. industry) concerned with the most important (or most interesting) R&D programmes in terms of innovation impacts. 10 focus groups were conducted in the course of the study in ten different countries: Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Poland, Sweden and the United Kingdom.

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[1] This is largely based upon work conducted over the past twenty years by some of the members of the ImpLore consortium.

Focus groups are an efficient and reliable way of collecting qualitative, assessment-based data. In contrast to interviews of individual experts, focus groups exert some amount of social control and tend not to overestimate the programme impacts since statements of individual experts can immediately be reflected upon and commented on by other experts. The particular strength of the focus group approach is thus to reduce a potential bias towards an overly positive self-assessment of programmes by their managers or responsible policy makers. Focus group discussions were primarily on the perception of innovation impacts, the relationship between design and management characteristics of programmes and whether there is a discernable relation between these and innovation impacts. They also focused on the strategies (including assessment and evaluation practices) used to enhance these impacts. See Appendix 6 for more information.

Analysis

The different information sources fed four types of analyses:

- Programme data, evaluations studies, the survey of programme managers as well as input from InnoImpact formed the basis for analysing design, management and evaluation features of R&D programmes that can have a distinct impact on innovation. The results of this analysis are reported in Chapter 3.1. They were used to map national R&D programmes with respect to their innovation impacts and derive generic conclusions on good practice in designing and managing R&D programmes for generating higher innovation outcome (4.1).

- Country reports and the survey of country experts were used to explore the role of R&D programmes as part of a wider range of strategies to stimulate innovation (3.2). A particular focus was put on New Member States, reflecting their peculiar innovation system and the progress of the current system of policy making (3.3).

- Reviews, evaluations and monitoring exercises of R&D programmes were worked through to identify feasible ways to analyse programme impacts and to learn from monitoring and evaluation exercises. Based on good practice examples conclusions were drawn on how to re-design R&D policy approaches for higher innovation impacts (4.3).

- A survey of programme managers provided a number of insights on key driving factors for increasing the innovation impact of R&D programmes (4.2) and were a major input for focus group discussions. The focus groups produced a number of good practice examples for R&D programmes that exert a significant direct or indirect impact on innovation (4.4).

All these analyses resulted in a set of policy conclusions on how to increase innovation impacts of R&D programmes (5.).

External Review and Advice

The ImpLore study profited heavily from various external reviews and advice:

- The InnoImpact consortium provided valuable input in terms of methodologies to innovation impact assessment of R&D programmes and which programme design and management features should be considered.

- A high-level Advisory Panel critically reflected on findings and (preliminary) conclusions of the study and validated the results. See Appendix 7 for more information.
- More than 230 participants of an ImpLore conference held in Berlin in October 2007 contributed to a better understanding of the link between public R&D funding and the commercial exploitation of R&D results. See Appendix 8 for more information.

3 THE ROLE OF R&D PROGRAMMES FOR STIMULATING INNOVATION

This chapter discusses ways of how public R&D programmes and initiatives could stimulate innovation. Particularly, we explore the role of the design, management and evaluation characteristics of R&D programmes as well as the role of situational variables such as a country's policy system and innovation system. As has been already stressed in the introductory chapter of the report, public R&D programmes are primarily designed to enable and increase R&D activities, i.e. provide R&D actors with additional resources to conduct R&D. A higher level of R&D activity is usually not the ultimate goal of policy, however. At the end of the day, R&D efforts should be transferred into some type of innovation i.e. into new products and processes that help to increase the level of productivity and the quality of life.

Over time, R&D policy came under increasing pressure to deliver innovation results (van der Knaap 2006). In order to meet this demand, R&D programmes are forced to consider their innovation environment more explicitly which means ingredients other than R&D that drive innovation success. Linkages among various private and public actors such as users/customers, suppliers, competitors, public research organisations, financial intermediaries, knowledge intermediaries, public authorities as well as access to education institutions are crucial in this respect. What is more, innovation success also depends on the institutional and social framework, both in terms of markets, legislation and cultural norms.

Considering these issues will make the design, management and evaluation of R&D programmes more complex. In the first section of this chapter (3.1), we discuss the various design, management and evaluation elements of public R&D programmes and how they are linked to innovation impacts. Section 3.2 explores the role of public R&D programmes as part of a wider approach to stimulate innovation, focussing particularly on the differences in the strategies and barriers to increase innovation impact across the EU member states. Section 3.3 specifically deals with the New Member States and the peculiar role of R&D programmes for upgrading innovation systems in (formerly) transition economies.

3.1 Main Features of R&D Programmes

A database including information about design, management and evaluation features of all major R&D programmes in the EU was developed and analysed. R&D programmes in the EU have the following characteristics:

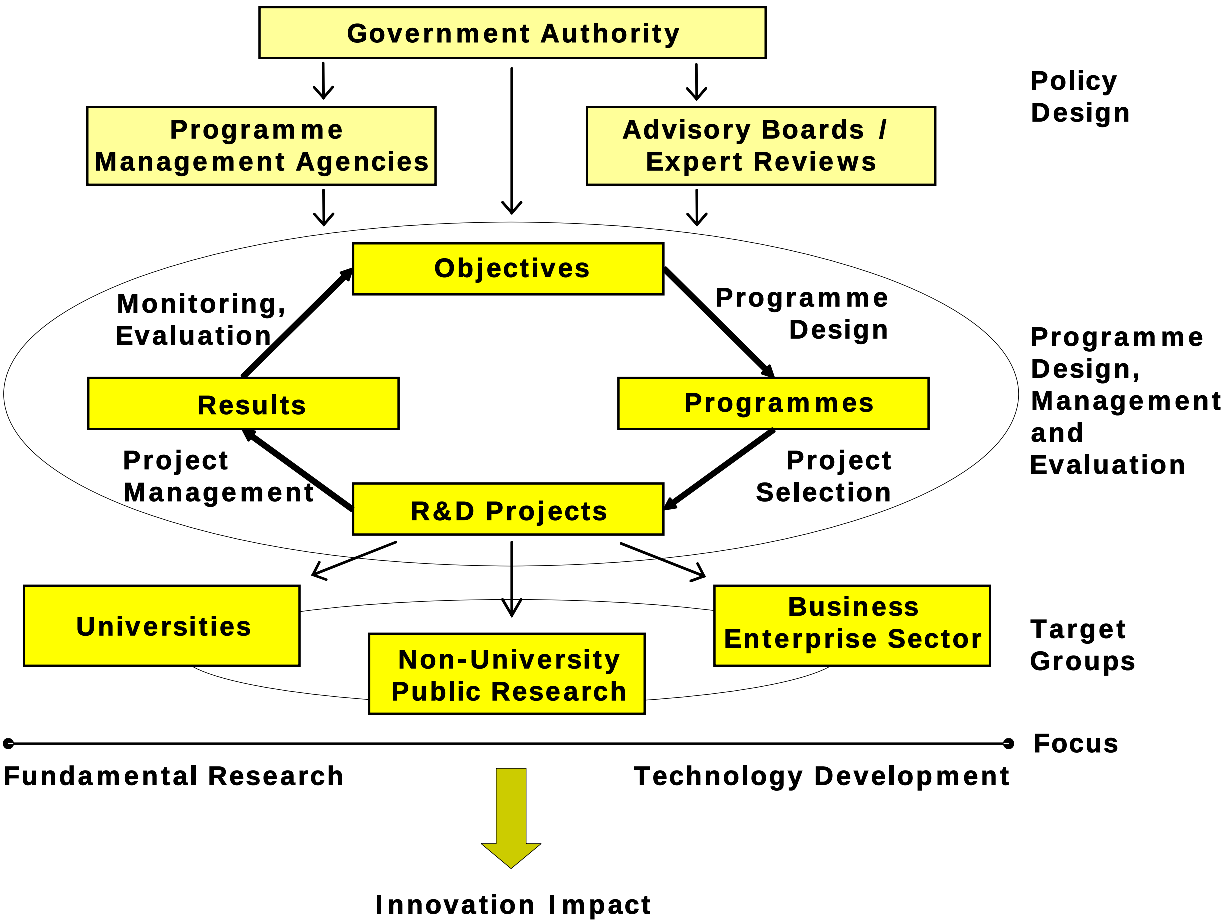
- R&D programmes are mainly designed by ministries of economic affairs and ministries of education and research.
- Collaboration is often required in order to receive funding.
- R&D programmes in Europe reward science/industry collaboration in particular.
- The majority of R&D programmes are managed by managing agencies, followed by ministry staff.
- Obligatory accountability is frequently applied to enforce funding contracts.
- R&D programmes in Europe are frequently evaluated.
- Evaluations are mainly conducted by the responsible ministry and programme management agencies.
- Surveys of beneficiaries and the analysis of monitoring data are frequently used as methods of evaluation.
- The indicators used for evaluations concentrate on labour input, money spent, outputs, patents and compliance with objectives.
- The main purpose of evaluation is to improve programme management and to assess impacts and effectiveness.

The ImpLore study applies a systemic view of the innovation process. The design, management and evaluation characteristics of R&D programmes define eligible beneficiaries and selection criteria, types of activities supported by a programme, monitoring processes and other issues that are relevant for innovation impact. Therefore, changes in the characteristics of R&D programmes can have potentially significant effects on the programmes' innovation impacts. The purpose of this section is to provide an overview of the main design, management and evaluation features of R&D programmes in Europe.

Van der Knaap (2006, p. 278) argues that "worldwide, governments are under increasing pressure to deliver results. There is a general recognition of the importance of performance measurement and a result-oriented focus for effective public management". As a consequence, publicly-financed support measures tend to shift their focus from a strongly input oriented approach to paying more attention to outputs, outcomes and impacts. Through this shift the issues of how to measure a programme's performance and which indicators are suitable for this purpose become pivotal. This move towards higher accountability of public investments is frequently called "performance management" or "results-oriented management".

Results-oriented public management is a process that links objectives, programmes, projects and results of a publicly support action. Figure 3 shows the main elements of such a process for R&D programmes which are supposed to play an important role for a programme's innovation impact. These elements should thus be considered carefully by the R&D programme managers in order to generate high innovation results from a programme's activities. The core part of the figure presents those programme elements on which this section focuses, i.e. the design, management and evaluation features. These are closely linked to the broader policy design and policy objectives. Government authorities, programme management agencies and advisory boards or expert reviews are important actors in this sphere and are thus a highly relevant group of stakeholders for the programme management. Another group of stakeholders are of course the potential beneficiaries of programmes, i.e. universities, other public research organisations and the business enterprise sector. Their capacities in terms of R&D and innovation resources and the barriers they face in conducting R&D and commercially exploiting R&D results are key points to consider for a successful results-oriented programme management.

Figure 3: Elements of results-oriented management of R&D programmes



Source: Own presentation based on Cozzens (2007).

The circle in the middle of Figure 3 contains those elements and activities of R&D programmes than can be affected by programme design and management. The process of setting programme objectives should be based on reviews, analyses and stakeholder involvement in order to get a realistic and relevant view of the issue and the role a certain programme can play within the wider context of policy making and challenges of the R&D and innovation system. Interaction between public and private actors from different backgrounds (for example, policy makers, policy advisers, programme managers, representatives from industry and public science) can help to come up with a balanced and evidence-based set of policy priorities. Another issue of defining objectives concerns the hierarchy of multiple objectives and potentially conflicting objectives. For instance, R&D programmes that target the advancement of basic research frequently address commercial exploitation as an objective as well. However, depending on the field of technology which is targeted, strengthening basic research (and making those results public to the scientific community) can be in conflict with a strategy of rapid exploitation of research results. Thus, the early phase of programme design can have an impact on the expected outputs and also on long term impacts.

Project selection links R&D projects with programme objectives. The rules governing project selection (eligibility criteria) should ensure that the projects selected for funding are in line with the more general objectives of a programme. Project selection may also include a process of aligning the layout of project submitted proposals to a programme's objectives and targeted activities, including communication with potential beneficiaries. When projects have been selected for funding, a project management can be set up by programme management which may include monitoring and reporting activities by beneficiaries and a regular analysis of project progress by the programme management. Finally, evaluations are used to assess the success of funded projects and the impacts of programme activities on the wider programme objectives.

The circle of results-oriented management shows that the different process elements of programme design, project selection, project management, and project/programme evaluation are interlinked, each element playing a decisive role in attaining the overarching goals. It also shows that the different process elements have to be coordinated and aligned. In the context of the ImpLore project, we are primarily interested in a programme's innovation impact as a key programme objective. The purpose of this section is to analyse how programme design, project selection processes, project management and evaluation processes are designed and coordinated and how these features of a programme are linked to innovation impact.

Database of R&D programmes

The empirical analysis presented in this section rests on a comprehensive database of public R&D programmes and initiatives run by national or regional authorities in the EU member states. The most relevant public R&D programmes that have had an impact on innovation were included in the database. R&D programmes that are included in the database are defined by the following characteristics:

- The duration of the programme is limited.
- The programme has a well-defined budget.
- It covers a pre-defined target group.
- The programme has pre-defined target activities.
- One of the aims of the programme is to foster innovation.

- The database covers current programmes and programmes completed within the last five years.
- The focus is on programmes on the federal (national) level.

This means that block grants to universities, permanent institutional subsidies, general R&D subsidies, and structural funds and other regional programmes are not included. The data contained in the database was collected by different means. On the level of ministries and programme owners/programme management agencies, there is public information available about the rules and regulations governing the R&D programmes. Important information sources about R&D programmes were the TrendChart and the ERAWATCH databases. Nevertheless, a considerable amount of original data had to be collected by different methods since not all kinds of information are publicly available. Additional data collection methods applied in order to fill the gaps in the database were personal interviews and telephone interviews with programme managers. The database covers a large number of variables (in total 71) that characterise R&D programmes. The variables are related to the following categories:

- History and genesis of the programme.
- General design of the R&D programme.
- Funding issues.
- Selection criteria.
- Project management.
- Project selection and programme execution.
- Monitoring of the projects.
- Programme management and evaluation.
- Impacts and outputs.
- Openness of the programmes.

The information contained in the programme database was used to categorise the different R&D programmes. Programmes were grouped in relation to the development of the innovation system and the type of R&D programme. With regard to the innovation system, the countries were grouped as New Member States, established innovation systems or catching-up innovation systems. Information about the objectives of the programmes enabled us to categorise the programmes as research-oriented, diffusion-oriented or industrial-R&D programmes. The database covers information about 431 R&D programmes in the EU.

When analysing characteristics of R&D programmes and the likely link between these characteristics and innovation output of R&D programmes, it is crucial to consider the policy system and innovation system context since both tend to strongly affect programme design and management on the one hand, and the scope of innovation impacts that can be attained by a programme on the other. Based on previous studies, country reports and an analysis of key features of national innovation systems (see section 3.2

for more detail), we apply the following country grouping (number of R&D programmes covered in the ImpLore programme database is given in parentheses):

- **New Member States**: Bulgaria (11), Cyprus (16), Czech Republic (25), Estonia (13), Lithuania (8), Latvia (4), Hungary (16), Poland (11), Romania (17), Slovakia (5), Slovenia (6) Malta (1).
- **Established innovation systems**: Finland (9), UK (14), Denmark (14), Luxembourg (12), Sweden (25), Germany (45), France (29), The Netherlands (17), Austria (19), Belgium (13).
- **Catching-up innovation systems**: Spain (26), Italy (15), Portugal (17), Greece (30), Ireland (13).

Another important programme dimension is the primary scope of a programme. R&D programmes can have a variety of purposes and underlying rationales according to the type of market or system failure they intend to tackle (see chapter 1). The scope of a programme will most likely affect a programme's innovation impacts, both in terms of explicitly aspired innovation results and not directly intended innovation impacts. Basically, one could distinguish R&D programmes focusing on basic research, on industry R&D and technological development, and on linking actors in order to facilitate the exchange and finally of knowledge and the diffusion of R&D results. In order to cluster programmes according to their primary scope, we executed a factor analysis based on information on the objectives of a programme (7 categories) and the types of projects funded through a programme (7 categories). The analysis resulted in the following grouping

- **Research-oriented programmes** (140 programmes) bundle programmes that have the following main objectives: "improve scientific knowledge", "exploit scientific knowledge", and "address social and environmental challenges". Types of R&D funded in these programmes include "basic research" and "applied research".
- **Industrial-R&D-programmes** (129 programmes) have objectives like "support industrial innovation" or "develop knowledge-based industries". Types of projects funded include "experimental development" and "industrial design".
- **Diffusion-oriented programmes** (162 programmes) comprise programmes with objectives like "increase internationalisation" and "develop industry/science relations". Types of projects funded include "knowledge and technology transfer", "dissemination" and "innovation".

Table 1: The relation between country grouping and the type of R&D programme

Programme type / *Country grouping*	*Diffusion-oriented programmes*	*Research-oriented programmes*	*Industrial-R&D-programmes*
New Member States	35%	29%	35%
Established innovation systems	30%	42%	28%
Catching-up innovation systems	28%	29%	43%

Source: ImpLore R&D programme database

Research-oriented programmes focus on rather "traditional" objectives of improving and exploiting scientific knowledge and funding basic and applied research projects. Programmes in this category tend to be oriented towards the research base (universities, public research institutions) as primary target groups as well as on industry-science R&D collaborations. In contrast, diffusion-oriented programmes aim at knowledge and technology transfer, dissemination, innovation and internationalisation. Industrial R&D programmes include programmes that aim at supporting industrial innovation and developing, particularly in knowledge-based industries. R&D projects that are funded in this group of programmes typically include experimental development and industrial design.

The relation between the group of countries and the type of R&D programme is shown in Table 1. It shows that the composition of the programmes is quite balanced. About 35% of all R&D programmes in the New Member States are diffusion-oriented, about 29% are research-oriented R&D programmes and 35% of all the R&D programmes are industrial-R&D-programmes. The composition is somewhat different in the established innovation systems where 42% of all R&D programmes were classified as research-oriented. Industrial-R&D programmes have a rather large share in the catching-up innovation systems since about 43% of all programmes can be classified as industrial-R&D-programmes. In general, the analysis of the ImpLore programme database indicates that all countries apply a mix of R&D programmes.

3.1.1 Design features of R&D programmes in Europe

A very basic feature of a R&D programme is the ministry that is responsible for the programme since it defines the objectives and goals and in most cases the management procedures and evaluation mechanisms as well. It can be assumed that R&D programmes that are under the responsibility of the economics or industry department have goals that are closer to the market whereas R&D programmes under the responsibility of the science ministry might be closer to basic research.

Table 2: The ministries responsible for R&D programmes

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Economic/trade/in-dustry ministry	33%	18%	17%	24%	12%	34%
Science and education ministry	32%	24%	34%	26%	39%	26%
Other ministries	2%	2%	4%	4%	4%	2%
Ministerial agency	9%	41%	18%	27%	19%	16%
Other	24%	15%	27%	19%	26%	22%

Source: ImpLore R&D programme database

As shown in Table 2, in the New Member States, both the economic and science ministries are responsible for R&D programmes. Ministerial agencies are mainly responsible for innovation systems trying to catch up. In the established traditional innovation systems, the main responsibility for R&D programmes is borne by the science and education ministries. With regard to types of R&D programmes, it can be observed that the R&D programmes that aim, in particular, at industry R&D are frequently under the responsibility of economic and trade ministries. The science and education ministries as well as the economic ministries have the responsibility for research-oriented programmes. Ministerial agencies frequently have the responsibility for research-oriented programmes. In diffusion-oriented programmes there is a clear tendency that science and education ministries have the responsibility for the R&D programmes.

Collaboration is an important element in every innovation system. Since "firms almost never innovate in isolation" (Edquist 1997, p. 20), the support of collaboration is a particularly vital element to foster processes leading to innovations in the form of new products or new services. Interaction and networking is an important factor behind the success of innovation systems since networking links important agents of the innovation system together, such as universities, non-university research institutes, private firms and governmental agencies. Thus, one could argue that since collaboration and networking increases the likelihood of innovation, R&D programmes that foster collaboration or programmes that make collaboration mandatory are likely to have a higher innovation impact.

Table 3: Mandatory collaboration of R&D programmes

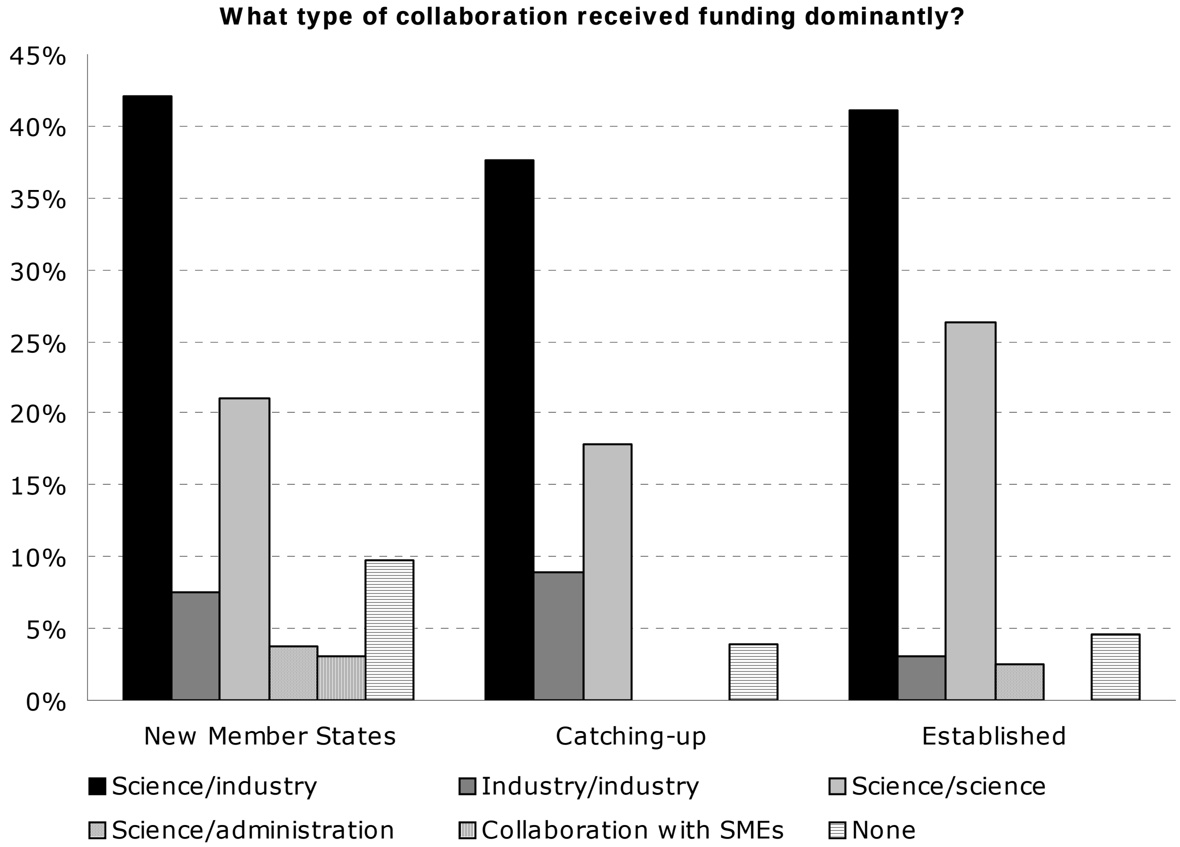
	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Share of programmes with mandatory evaluation	38%	49%	60%	53%	54%	42%

Source: ImpLore R&D programme database

Mandatory collaboration is widespread in R&D programmes. Table 3 shows that collaboration is mandatory for the majority of R&D programmes in the established innovation systems. The share of R&D programmes with mandatory collaboration is considerably smaller in the New Member States and for the innovation systems that are catching up. Collaboration is mandatory in the majority of research-oriented and diffusion-oriented programmes and R&D programmes that focus particularly on industry R&D are less inclined to demand collaboration.

R&D programmes encourage different types of collaboration. One can distinguish between industry/science collaboration where a firm collaborates with a public research organisation or industry/industry collaboration where firms collaborate with each other. Furthermore, R&D programmes can fund science/science collaboration and collaboration between science organisations and the public administration, for instance, municipalities. Additionally, a number of R&D programmes encourage collaboration with small and medium-sized enterprises (SMEs). This type of collaboration is likely to make a difference on innovation impact. The innovation impact from industry/science collaboration will probably be different from the impacts of science/science or industry/industry collaboration.

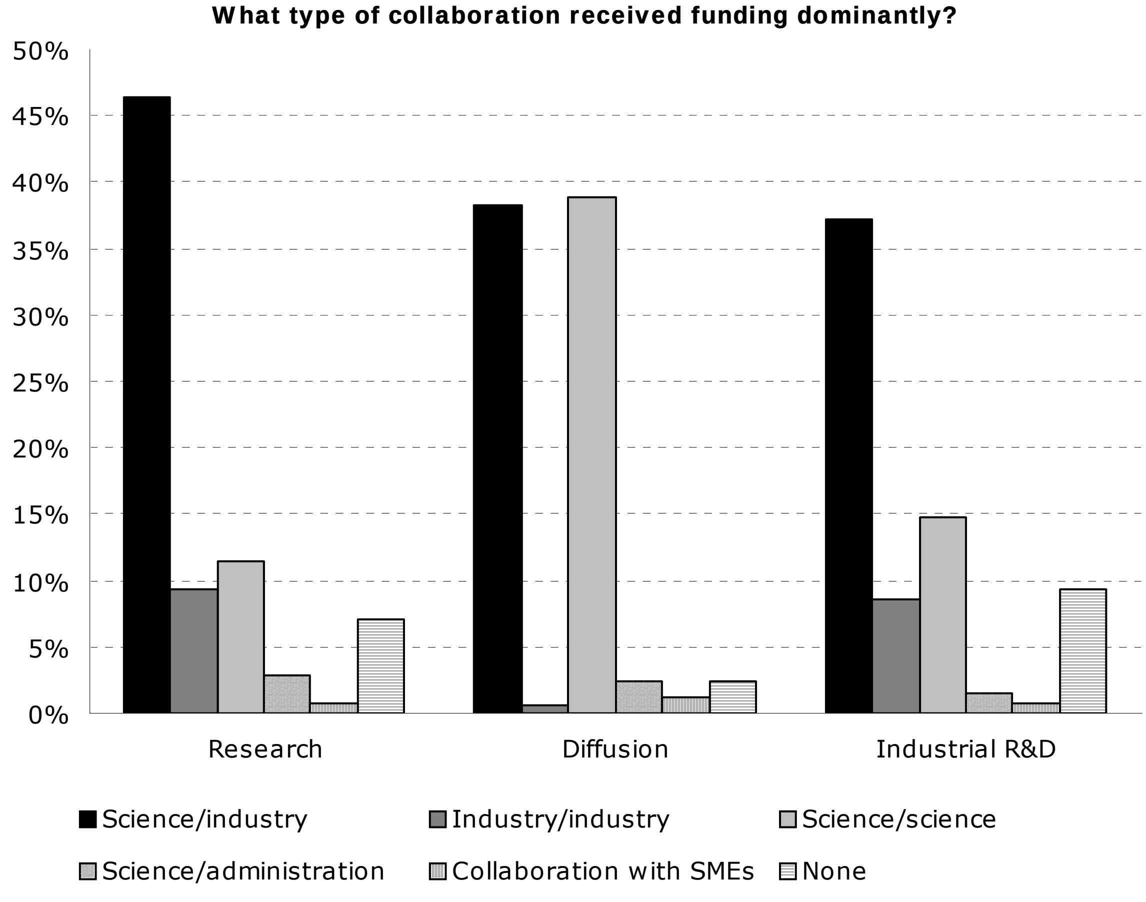
Figure 4: Type of collaboration in R&D programmes by country grouping



Source: ImpLore R&D programme database

The country differences are rather small as depicted in Figure 4. Science/industry collaboration is the dominant form of collaboration. The collaboration between actors from industry and research organisations is important for the transfer of knowledge and technology. It serves an important function in an economy since it connects the university research and non-university research institutes with industrial firms. Science/industry collaboration is important for the commercial exploitation of research results from public research organisations. Science/science collaboration is a form of collaboration that integrates and strengthens the innovation system since it enables the transfer of knowledge between different universities and non-university research institutes. All the innovation systems fund science/science collaborations as well. In general, industry/industry collaboration is rather rare; however, it is more frequent for innovation systems that are catching-up and the New Member States than for the established innovation systems. In general, it can be argued that the type of collaboration depends heavily on the structure of the research system and the absorptive capacities and capabilities of the different actors to access and take advantage of knowledge produced by other actors.

Figure 5: Type of collaboration in R&D programmes by type of programme



Source: ImpLore R&D programme database

When looking at the types of R&D programmes in Figure 5, interesting differences can be found. The dominant form of collaboration in research-oriented programmes is science/industry collaboration. Industry/industry and science/science collaborations occur but to a far lesser extent. Diffusion-oriented R&D programmes fund mainly science/industry and science/science collaboration whereas the other types of collaboration are of minor importance. Industrial-R&D programmes mainly fund science/industry collaboration. Science/science collaboration and industry/industry collaboration are encouraged as well, however, to a lesser extent.

3.1.2 Management features of R&D programmes in Europe

Management features of R&D programmes define and regulate the processes that govern the administration and management of the R&D programme. The programme management is important for the success of the R&D programmes since it includes procedures such as the selection of project proposals, reporting rules and monitoring and enforcement of funding contracts. The organisation of R&D programmes and programme management is different in the various EU member states. The majority of programmes are managed by a managing agency, as shown in Table 4. This share is the highest in the established innovation systems and the research-oriented programmes. However, the type of managing agency varies across Europe. In some countries, for instance Germany, there are a number of different managing agencies whereas in smaller countries, such as Sweden, basically one agency is responsible for all R&D programmes. The ministries have an important role as managers of R&D programmes in the New Member States and the catching-up innovation systems. The category 'other' includes a diverse set of actors such as business representatives, foundations and research councils.

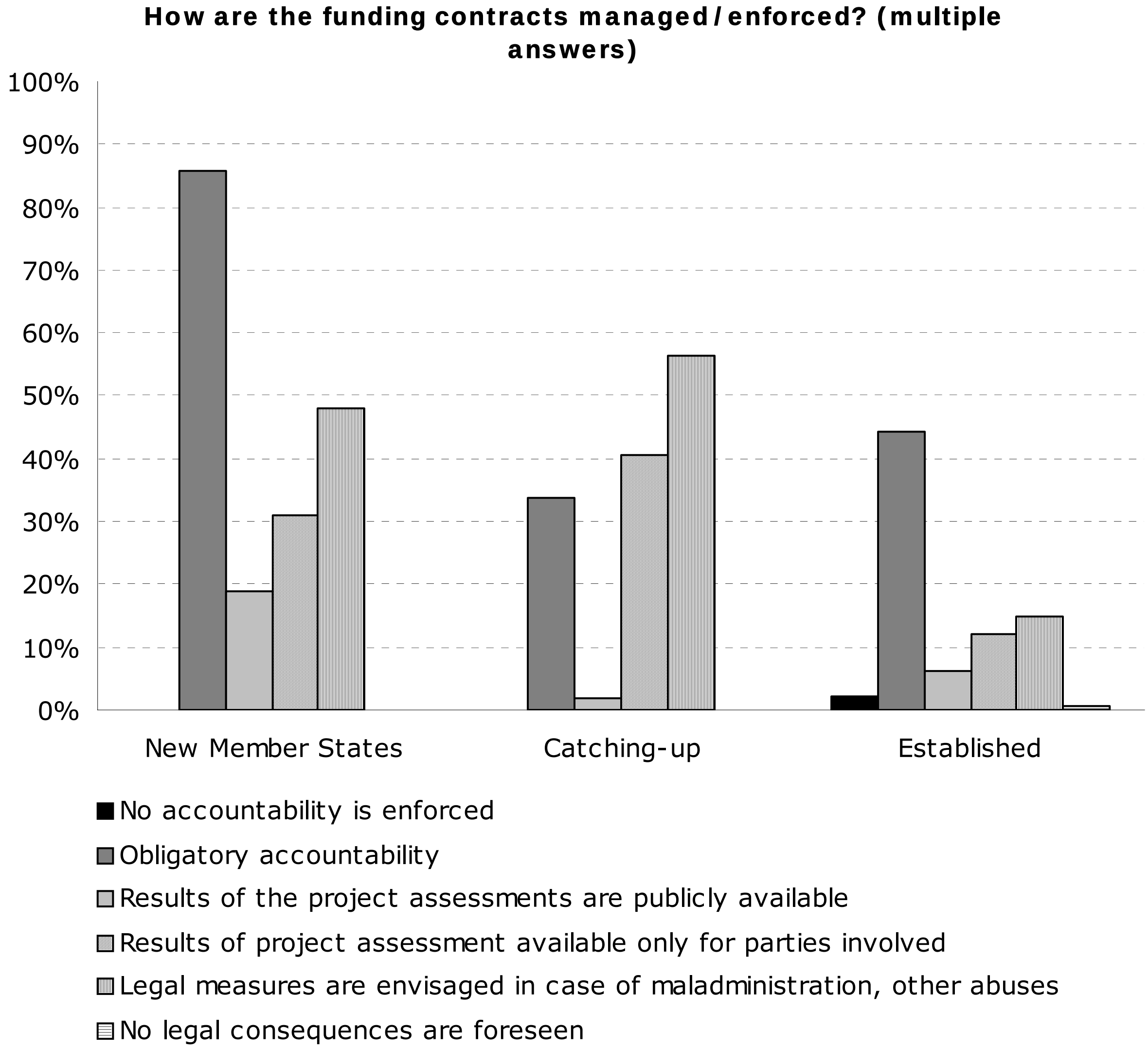
Table 4: Organisations responsible for programme management

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Ministry staff	33%	32%	16%	20%	27%	27%
Managing agency	45%	52%	54%	60%	46%	47%
Private firm	0%	1%	1%	1%	0%	0%
Academic institution	4%	0%	3%	1%	6%	1%
Other	18%	15%	26%	18%	21%	25%

Source: ImpLore R&D programme database

The enforcement of funding contracts is an important issue with regard to the management of R&D programmes. Different enforcement options are in place. These include obligatory accountability and mandatory publication of the assessment results to a wider public. Furthermore, management procedures of R&D programmes can also foresee legal actions in case of proven maladministration or other abuses. There is considerable variety in contract enforcement, as illustrated by Figure 6. The vast majority of R&D programmes in the New Member States apply obligatory accountability. This is different for the catching-up innovation systems, where only about one third of the R&D programmes apply obligatory accountability. Results of project assessments are rarely available to the public. However, such assessments are more frequently available in the programmes of the New Member States than in the catching-up and established innovation systems.

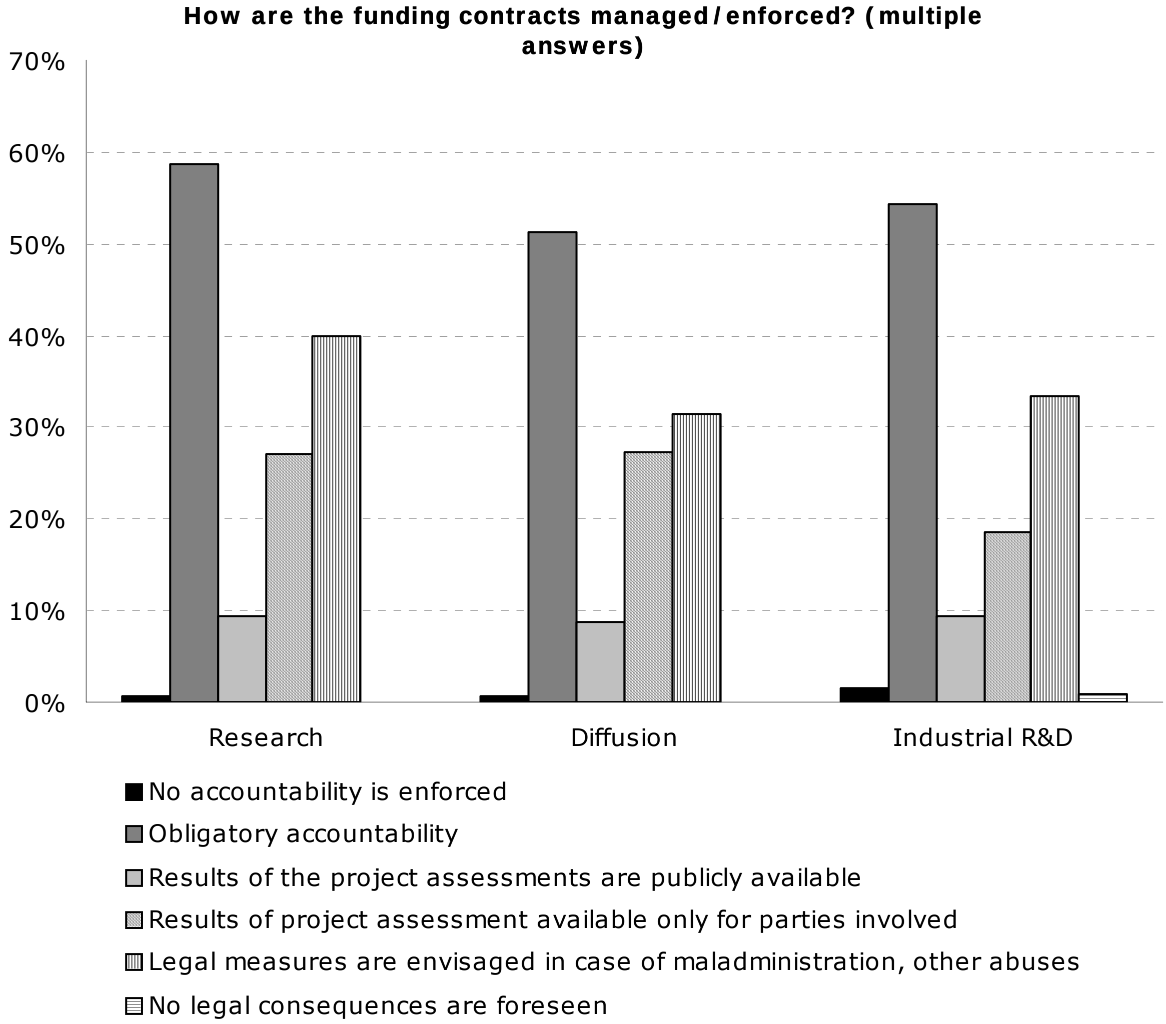
Figure 6: Type of contract enforcement by country grouping



Source: ImpLore R&D programme database

The type of contract enforcement used in R&D programmes does not vary much with respect to the type of R&D programme as shown in Figure 7. Obligatory accountability is applied in all three types of programmes most often, followed by legal measures in case of maladministration or other abuses.

Figure 7: Type of contract enforcement by type of programme



Source: ImpLore R&D programme database

3.1.3 Evaluation features of R&D programmes in Europe

Table 5 shows that most of the R&D programmes in Europe are reviewed on a regular basis. It seems that the catching-up countries put particular emphasis on programme evaluation since about 95% of their programmes are evaluated. This share is considerably smaller in the established innovation systems where about 81% of the R&D programmes are regularly evaluated. There is an indication that the orientation of the programme matters for evaluation procedures, since 92% of the research-oriented programmes are also evaluated regularly whereas this is true for only 81% of the industrial-oriented programmes.

Table 5: Review and Evaluation of R&D programmes

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Share of programmes being evaluated	87%	95%	81%	92%	85%	81%

Source: ImpLore R&D programme database

R&D programmes are frequently evaluated by ministries, programme management agencies and external national evaluators as illustrated in Table 6. Ministries frequently evaluate R&D programmes in the New Member States and catching-up innovation systems. Programme management agencies have an important role in the established, traditional innovation systems but also in the catching-up economies. Research-oriented R&D programmes are mostly evaluated by programme management agencies, whereas ministries more frequently evaluate diffusion-oriented programmes and industrial R&D programmes. External national evaluators also frequently evaluate R&D programmes in particular diffusion-oriented programmes.

Table 6: Organisations responsible for evaluating R&D programmes

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Government/ministry	55%	55%	13%	36%	33%	40%
Programme management agency	30%	48%	26%	40%	26%	32%
External national evaluators	30%	31%	23%	27%	29%	24%
External international evaluators	13%	6%	14%	10%	12%	12%

Source: ImpLore R&D programme database

Table 7 indicates the methodologies involved in the evaluation of R&D programmes. It shows that qualitative methods based on interviews, surveys of beneficiaries and case studies are frequently used to evaluate R&D programmes. In contrast, quantitative approaches that enable the evaluator to analyse questions related to additionality, such as control group approaches or economic modelling, are rarely used in practice.

Analysis of monitoring data is the most frequent method in the New Member States and the catching-up innovation systems. Qualitative interviews with management, beneficiaries and stakeholders are frequently used in the established innovation systems. A striking result is that economic modelling is rather frequently used in catching-up innovation systems, however it is rarely implemented in the New Member States and the established innovation systems.

Table 7: Methodologies applied in evaluation

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Qualitative interviews with management, beneficiar-ies, stakeholders	34%	35%	38%	34%	39%	35%
Case studies	18%	22%	15%	19%	17%	16%
Survey of beneficiaries	40%	28%	29%	34%	31%	31%
Control-group approaches	4%	4%	5%	3%	6%	4%
Economic modelling	1%	31%	4%	14%	5%	9%
Analysis of monitoring data	60%	46%	24%	46%	38%	37%

Source: ImpLore R&D programme database

When R&D programmes are classified by their objectives, interesting results occur. The research-oriented R&D programmes mainly apply analysis of monitoring data. Qualitative interviews and case studies are also common. Economic modelling is not used frequently. The diffusion-oriented R&D programmes apply qualitative interviews more often than analysis of monitoring data. Industry R&D programmes use analysis of monitoring data more often than qualitative interviews. Survey approaches are used to roughly the same extent regardless of the type and objective of the R&D programmes.

Table 8: Indicators reported in evaluations

	Country grouping			*Type of programme*		
	New Mem-ber States	*Catching-up*	*Estab-lished*	*Research*	*Diffusion*	*Industrial R&D*
Labour input	58%	46%	52%	54%	57%	43%
Money spent	77%	57%	60%	69%	69%	55%
Output	53%	46%	57%	58%	58%	42%
Publications	50%	28%	51%	39%	62%	32%
Patents	50%	25%	36%	33%	47%	31%
New companies set up	8%	23%	23%	19%	19%	16%
Compliance with ob-jective set	68%	53%	46%	61%	56%	45%
Profitability	5%	20%	8%	13%	6%	12%
Return on subsidy (investment)	9%	28%	5%	16%	9%	11%
Progress Reports	5%	1%	1%	2%	1%	5%

Source: ImpLore R&D programme database

The indicators that have to be reported are highly relevant with regard to innovation impacts. It can be assumed to a reasonable extent that programmes that demand the reporting of innovation-related indicators, such as patents or setting up of new companies, are also more oriented towards innovation. Different indicators measure different kinds of outputs. Recording publications measure the scientific output of R&D programmes, whereas new companies set-up and return on (subsidy) investment are more commercially-oriented indicators.

The analysis of the database shows that R&D programmes have a large variety of different indicators (Table 8). Money spent is the most widely used indicator in all programmes and countries. Compliance with the objectives set is also assessed regularly. The number of people involved in the projects is also measured regularly. Publications and patents are equally important as a performance measure. However, whereas publications and patents are used as indicators almost as frequently as each other in the New Member States and the catching-up innovation system, their use is different in the established innovation systems. In the established innovations systems, publications are more often used as an indicator than patents. Different types of R&D programmes have different reporting obligations. As one might expect, publications and patents seem to be equally important in the industry R&D programmes, whereas publications are more important as performance indicators in the research-oriented and diffusion-oriented R&D programmes. An important indicator for innovative activity is start-ups, since start-ups can be interpreted as an endeavour to commercialise research results from publicly-funded R&D projects. The establishment of firms, particularly for high technology industries, is a highly relevant indicator that measures the process of "creative destruction". New companies set-up is an important indicator in the established traditional innovation systems and the catching-up national innovation systems. New companies set-up is equally common as an indicator for innovation regardless of the type and objective of the programme.

Table 9: Purpose of evaluation

	Country grouping			*Type of programme*		
	New Member States	*Catching-up*	*Established*	*Research*	*Diffusion*	*Industrial R&D*
Improving programme management	50%	42%	29%	37%	44%	33%
Re-design of eligibility/selection criteria	38%	36%	11%	24%	24%	27%
Assessing impacts/effectiveness	62%	70%	35%	60%	48%	48%

Source: ImpLore R&D programme database

Evaluation serves different purposes. The most important purpose of evaluating R&D programmes is to assess the impacts and effectiveness as depicted in Table 9. There are interesting country differences. Evaluations in the New Member States are more frequently used to improve programme management than in the catching-up countries and the traditional innovation systems. With regard to the type of programme, similar results are shown. For all types of programmes, assessing the impacts and effectiveness of R&D programmes is the most important purpose of evaluation followed by improving programme management and the purpose to re-design eligibility or selection criteria.

The analysis of the programme database provides the following indications regarding the characteristics of R&D programmes in Europe:

- R&D programmes are mainly designed by ministries of economic affairs and ministries of education and research.
- Collaboration is often required in order to receive funding.
- R&D programmes in Europe reward science/industry collaborations in particular.
- The majority of R&D programmes are managed by managing agencies, followed by ministry staff.
- Obligatory accountability is frequently applied to enforce funding contracts.
- R&D programmes in Europe are frequently evaluated.
- Evaluations are mainly conducted by the responsible ministry and programme management agencies.
- Surveys of beneficiaries and the analysis of monitoring data are frequently used as methods of evaluation.
- The indicators used for evaluations concentrate on labour input, money spent, outputs, patents and compliance with objectives.
- The main purpose of evaluation is to improve programme management and to assess impacts and effectiveness.

3.2 R&D Programmes as Part of a Wider Range of Strategies to Stimulate Innovation

R&D programmes have to be seen in the context of the broad range of strategies to stimulate innovation. Country experts identified:

- The top 20 barriers to increasing innovation impact.
- The top 20 strategies used to increase the impact of innovation.
- The relative prevalence of these barriers and strategies in EU countries and their ranking in terms of perceived impact.

The relative importance of these generic strategies in any specific country appears to be quite dependent on situational variables like country size, R&D-intensity and maturity of innovation systems.

While the focus of the ImpLore project is on R&D programmes, it becomes clear that there are a broad number of factors in the innovation system that influence the innovation impacts besides design, management and evaluation characteristics. As already mentioned, the ImpLore project adopts a systemic perspective that takes into account a broad range of determinants of the innovation processes including economic, social, political, and institutional factors that influence the innovation impacts of R&D programmes. The country reports enabled the ImpLore consortium to extract the most relevant characteristics of innovation systems that act as barriers or accelerators for generating impact.

It was very clear from various sources[2] that there is a diverse range of strategies to stimulate innovation that can be observed on both the national and the regional level. Public funding of R&D underpins some of these strategies either directly or through complementary knowledge transfer or commercialisation programmes. There are of course other public sector interventions that are aimed at stimulating wider forms of innovation that are not based on the outputs of R&D (for example, service innovation) but these are outside the scope of this study.

One of the key issues for the study was how to classify the diversity of R&D-related strategies and their relative importance in terms of their impact on innovation. It was obvious that this could not simply be achieved by focusing narrowly on public funded R&D programmes as the impact of these cannot be considered in isolation from higher level policies and innovation support measures. The latter [innovation support measures] may be an 'accompanying measure' to a public R&D programme but can also be implemented by ministries or agencies not directly connected to the R&D programme. Regional Organisations also play a leading role in innovation support programmes in some countries.

[2] Published ERA reports, a survey of national programme managers in the form of questionnaires and the broader tacit knowledge of the ImpLore consortium from previous studies.

The approach to the classification and prioritisation of strategies was based on the country-specific knowledge that had been developed within the team of ImpLore country experts[3] before and during the study. This was achieved in two stages, following a Delphi survey approach.

In the first stage, country experts for all 27 EU Member States produced an internal report on the situation and strategies in that country with respect to seven factors[4]. The resulting horizontal synthesis produced a longlist of nearly 150 specific barriers and strategies (related specifically to the impact on innovation from public R&D) that were prevalent across EU countries. Detailed analysis produced a shortlist of the top 20 generic barriers and strategies. These could then be segmented into four main areas; science & innovation policy, R&D programmes, science base and industrial base. This provided the framework for the 2nd stage.

In the second stage, the country experts ranked the shortlisted generic barriers and strategies in terms of their relative prevalence in the specific country and to what extent they appeared to influence the impact on innovation of public R&D. This not only enabled an overall prioritisation (Section 3.1) but also highlighted significant differences in the relative ranking between different countries (Section 3.2).

This appears to confirm our initial hypothesis that strategies are dependent on the situation in a particular country. It is hardly surprising that this may be the case when one considers the diversity of countries across the EU27 Member States and their relative investment in public R&D (Section 3.2.1). There are a number of country-specific variables that might affect R&D and innovation policy and programmes. The most effective strategy for a particular country will be influenced by variables like country size/wealth, regional diversity, the science base, the structure and R&D intensity of the industrial base and the number of graduates and other key assets that underpin knowledge-based economies. The use of EU Structural Funds to supplement public R&D may also affect the design of R&D and innovation programmes in a particular country. These variables are discussed further in Section 3.2.2 and provide the introduction for a concluding analysis of the relative prevalence of barriers and strategies (Section 3.2.3) in five different types of EU Member States (based on country size, R&D intensity and innovation system maturity).

3.2.1 Generic barriers and strategies

The 1st stage of the Delphi Survey allowed us to shortlist the most prevalent strategies and barriers across the EU Member States based on the opinion of the ImpLore country experts that carried out the mapping of national programmes and strategies. The 2nd

[3] The ImpLore consortium was enhanced by expert subcontractors to create an extended team of country experts who provided qualitative information on R&D structures and programmes to support the mapping of national R&D programme strategies

[4] Research & innovation policy, public sector organisations, impact evaluation, R&D programme design, R&D programme management, exploitation of public R&D and business-funded R&D.

stage allowed us to rank them by presence and perceived impact on innovation[5]. The shortlist and rankings are shown in Table 1 (barriers) and Table 2 (strategies).

Table 10: Top 20 barriers to increasing innovation impact

	Barriers to Innovation Impact	*Ranked Presence*	*Ranked Impact on Innovation*
Science & Innovation Policy	Lack of an integrated approach to science and innovation policy	11	8
	Lack of effective coordination between R&D ministries and innovation agencies	18	17
	Non-systemic approach to innovation support	8	15
	National R&D spending is low	5	7
	National R&D spending is increasing	20	20
R&D Programmes	Too many programmes/actions leading to complexity, diluted resources & bureaucracy	13	19
	Creation of programmes without reference to/evaluation of past programmes	19	11
	Low level of SME-specific funding support in programmes	15	16
	Lack of evaluation evidence on impact of R&D programmes	1	9
	Lack of transparency in programme management and project evaluation funding	17	18
Science Base	Poor links between science and industry	2	1
	Focus on the development of basic rather than applied & experimental research	13	13
	Lack of R&D capacity due to a shortage of researchers in the country (both public and private)	6	10
	Lack of encouragement and support for the commercialisation of research	12	12
Industrial Base	Lack of innovative companies (R&D absorptive capacity)	9	5
	Majority of private R&D by small number of large/well established companies	3	2
	Low level of SME investment in (both public and private) R&D	4	3
	Shortage of R&D intensive companies that are able to participate in programmes	8	4
	Lack of / insufficient structures and measures to encourage private sector R&D	16	14
	Lack of support to develop absorptive capacity of firms	7	6

Source: ImpLore country reports.

This appears to show that there is a relatively high prevalence of certain barriers that have a high impact on innovation. For example:

- *Poor links between science and industry* – This was ranked 1st on impact on innovation and was the 2nd most prevalent barrier

[5] The ranking process was semi-quantitative. The country experts were asked to give each barrier and strategy a score from 0 to 3 in terms of both prevalence in that country and perceived impact on innovation. Zero was no prevalence or impact, 1 was 'low', 2 was 'medium' and three was 'high'

- *Majority of private R&D by small number of large/well established companies* – This was ranked 2nd on impact on innovation and was the 3rd most prevalent barrier
- *Low level of SME investment in (both public and private sector) R&D* – This was ranked 3rd on impact on innovation and was the 4th most prevalent barrier

The most prevalent was *Lack of evaluation evidence on impact of R&D programmes* but this was seen as less important to the impact on innovation than those above.

Table 11: Top 20 strategies used to increase the impact of innovation

	Strategies to Increase Innovation Impact	*Ranked Presence*	*Ranked Impact on Innovation*
Science & Innovation Policy	Significant governmental & societal focus on and/or investment in innovation	5	2
	Development of a national innovation policy/strategy (integrated science/innovation policy)	8	1
	Definition of long-term thematic priorities	19	9
	Increasing use of competitive programmes (in place of institutional funding)	6	14
	Commitment to/promotion of international cooperation	16	12
	Coordinating structures for administration and funding of ST&I	15	18
R&D Programmes	Programmes that encourage/require links between science & industry	1	3
	Consolidation of programmes in a limited number of nationally important themes	11	19
	Use of thematic programmes	4	10
	Programme monitoring and evaluation leading to continual improvement	3	8
	Development of collaborative sectoral clusters/networks for R&D	12	16
	Use of national/international experts to support programme design and/or implementation	14	17
Science Base	Development and support of competence centres of expertise/excellence	2	5
	Development of innovation infrastructure - tech parks, incubators, tech transfer centres	17	13
	Focus on increasing the exploitation of public R&D results by industry/SMEs	7	6
	Support for commercialisation of research results achieved at public research institutions	13	15
	Support to encourage increased employment in R&D/making science careers attractive	20	4
Industrial Base	Focus on increasing R&D expenditures of SMEs (share of R&D performed by SMEs)	18	20
	Industry/SMEs encouraged to engage with the science base	9	7
	Fiscal incentives for R&D	10	11

Source: ImpLore country reports.

This appears to show that the most prevalent strategies are focused on the programme level (1st, 3rd and 4th) and the science base (2nd most prevalent strategy). The top five in terms of perceived impact on innovation were:

- *Development of a national innovation policy/strategy (integrated science/innovation policy)* – This is ranked 1st on impact on innovation but only 8th in terms of prevalence. This strategy can be observed in countries like the Netherlands and the UK.

- *Significant governmental & societal focus on and/or investment in innovation* – This is ranked 2nd on impact on innovation and 5th on prevalence. This is unsurprising as most countries in Europe are pursuing knowledge economy policies in response to competition from low cost countries.

- *Programmes that encourage/require links between science and industry*– This is ranked 3rd on impact on innovation and 1st on prevalence. This is a very obvious strategy, particularly for countries with a strong science base.

- *Support to encourage increased employment in R&D/making science careers more attractive* – This is ranked 4th on impact on innovation but only 20th on prevalence. It is presumably linked to concerns about scientific skills as innovation becomes a more important national policy issue and countries increase their investment in R&D.

- *Development and support of competence centres of expertise/excellence* – This is ranked 5th on impact on innovation and 2nd on prevalence. Clearly this is quite a popular strategy and further evidence was the FP6 ERA-NET that was created on this subject (COMPERA).

There were also some significant differences in prevalence rankings between different types of countries. The reasons for these situational differences are discussed in Section 3.2 below. This includes a simple analysis of the relative differences in prevalence between five types of countries, based on three situational variables.

3.2.2 Situational Strategies

European Diversity

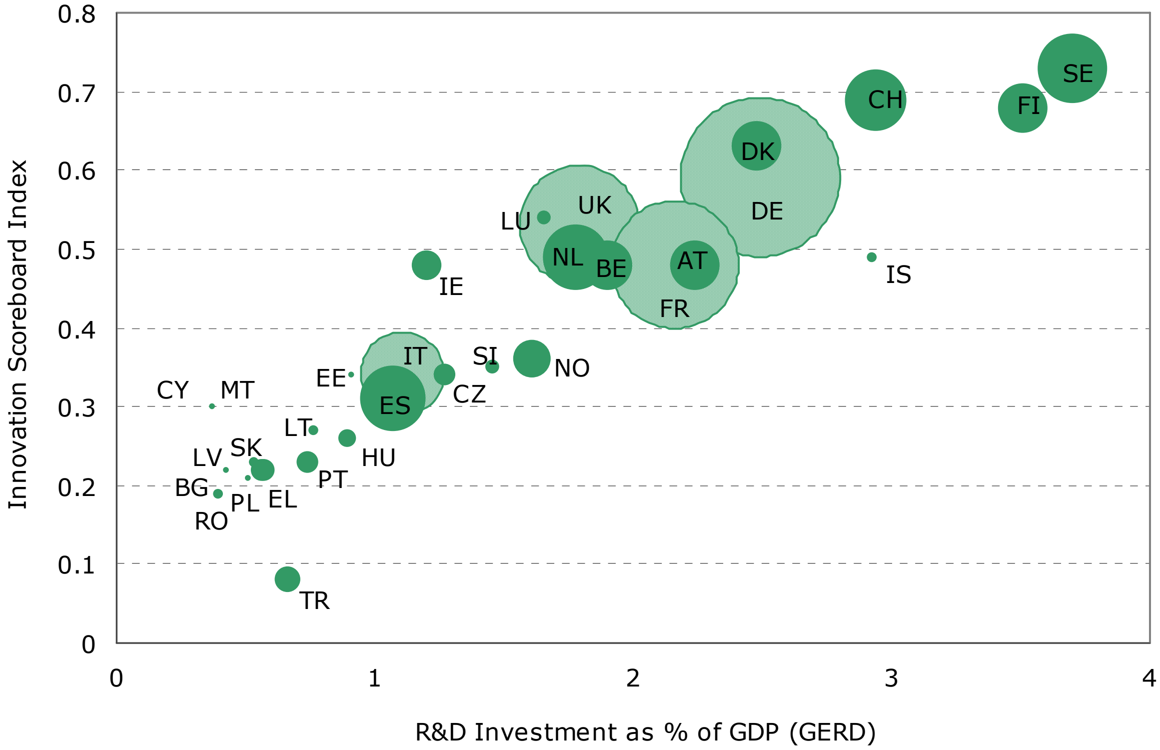
According to Eurostat[6] statistics, R&D investment by national administrations across the EU is around €200 billion and this will increase as Member States take action to achieve the Barcelona 3% targets. This will, of course, require an increase in the level of business expenditure in most countries as well as increased public sector investment.

The EU statistics on national expenditure on R&D are complemented by more detailed statistics related to innovation inputs and outputs. These are being monitored through the annual European Trend Chart[7] on Innovation and each country's performance is

[6] Science, Technology & Innovation in Europe, Eurostat, 2007
[7] http://trendchart.cordis.europa.eu/

presented as a single Summary Innovation Index (SII)[8] within the European Innovation Scoreboard (EIS). The EIS Index for each country is compared with the gross R&D investment in Figure 8. Here the size of the circle represents the gross annual investment in R&D.

Figure 8: Comparison of GERD to European Innovation Scoreboard performance



Source: European Innovation Scoreboard, own presentation.

This provides a very clear indication of the huge diversity of R&D investment and innovation performance across EU Member States It would therefore seem logical that the most appropriate strategies to maximise the impact on innovation of public R&D investment might also vary considerably depending on the particular country situation.

Situational Variables

As discussed in the introduction to this Chapter, there are a number of situational variables that may have an influence on whether a particular strategy will be effective in a given situation. Such variables would include:

Country size and wealth: The size and wealth of the country will have a significant bearing on the gross investments in R&D. The ability to invest in science and innovation is clearly dependent on the relative wealth in any country and the key indicator of this (GDP per capita) varies by more than one order of magnitude across the EU27 countries.

8 The Summary Innovation Index (SII) for each country is a composite of 25 individual indicators covering five EIS themes: innovation drivers, knowledge creation, innovation and entrepreneurship, application and intellectual property.

Size and scale of investment also seems to have an influence on the overall management and exploitation systems. This has led to some quite fragmented structures in the larger countries spanning a variety of ministries and agencies. Smaller, R&D intensive countries like Austria, Finland, Netherlands and Sweden have a more integrated structure with a single Research Council and Innovation Agency. Some countries channel their R&D investment directly into universities and/or public research institutes.

Regional variations: In some countries there are significantly different variations in economic performance, federal structures and industrial strengths & weaknesses that make it difficult to design national R&D programmes that are appropriate for all regions. For example, regional GDP/capita in both Italy and Spain varies from 50 to over 125 of the EU27 index and there are significant regional disparities in France, Germany and the UK. Some countries have responded to this by implementing regional R&D programmes and these are most obvious in Belgium, Germany, Italy and Spain. Regional autonomy to develop R&D programmes appears to be a trend in some of the other countries (for example in the UK).

Science base: The relative strength of the science base appears to be an important factor in the design of national R&D programmes both in a general sense and with respect to strategies to increase the impact on innovation. Countries with a strong science base (for example, Germany[9]) tend to focus on specific thematic priorities because of the competition for public R&D funding. More recently, some countries have prioritised their R&D investment based on a strategic synthesis of both scientific & industrial strengths and societal challenges. Many such countries are also creating R&D programmes that are centred around science/industry networks (for example, the French Pôles de Compétitivité). The less R&D-intensive countries tend to be less thematic in their approach to public R&D funding.

Industrial base: The structure, distribution and technological intensity of the industry in any country are also important factors for the design of national R&D programmes. The flow of foreign direct investment (FDI) into a country can have a significant positive impact on the business R&D statistics for emerging economies, particularly if the incoming business is R&D-intensive. Eurostat figures indicate that Luxembourg, UK and France have the highest in-flows of inward investment from other EU27 countries (intra-EU). The same three countries, along with Germany, account for the majority of inward investment from outside the EU, with the UK well ahead of the others. Poland, Romania, Hungary, Czech Republic and Bulgaria respectively are the leaders in receiving FDI from other EU Member States. Also, there are quite significant variations in manufacturing vs. service industry intensity across the EU countries and regions. Over the past 10 years the trend in public R&D investment has been towards thematic programmes that are primarily aimed at supporting the development of high-tech industries (for example, ICT, life sciences and nanotechnology). This tends to be complemented by SME-specific programmes that are more open and, generally, less competitive. There are also indications in some countries (for example, Sweden[10]) that sector-specific programmes are making a comeback. One area that appears to be rather weak in R&D programme design is related

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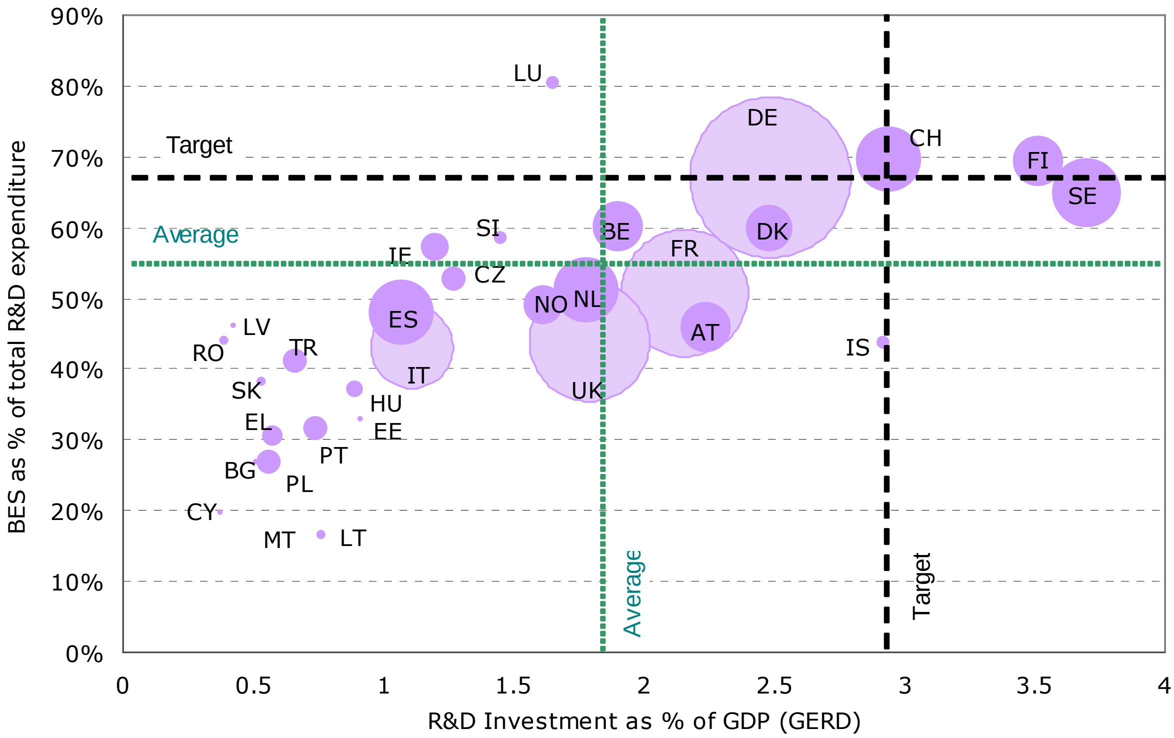
[9] Germany now has a High-Tech Strategy (with 17 thematic areas) and is investing €600m in clustering initiatives through the Spitzencluster-Wettbewerb programme

[10] In Sweden, the national innovation agency (VINNOVA) has recently established both an SME-specific programme and also a number of sector-specific programmes to complement its thematic R&D programmes.

to the service sector despite the relative growth of high-tech service industries in Europe. This fact was highlighted by a number of speakers at the 2008 ImpLore Conference in Berlin. In some cases, these industries (for example, ICT/software) are able to participate in thematic programmes. In others, there is a growing trend towards supporting such industries through some of the socio-economic research programmes.

R&D intensity of the industrial base: In section 3.2.1, we highlighted the significant differences in the distribution of gross national investment in R&D (GERD) between public and private sector sources. Clearly, the level of private sector R&D will have a more direct impact on innovation than that of the public sector R&D programmes, which tend to have broader societal objectives. Figure 9 gives an indication of the R&D intensity of the business enterprise sector in each country.

Figure 9: Gross expenditure on R&D and investment by business



Source: European Innovation Scoreboard, own presentation.

Clearly there continues to be a huge variation between EU countries both in terms of relative R&D investment and the presence of research-intensive industries that are able to exploit the outputs of R&D through innovation. Figure 2 (dashed lines) also highlights where countries are placed relative to the Barcelona 3% target, including the assumption that two-third (67%) of the total should be invested by industry. Most EU countries are well below these targets (the average is indicated by the dotted lines) and this has an influence on R&D programme policy and designs in many countries. For example, industrial R&D programmes generally require co-funding (typically at least 50%) and this desire to leverage higher levels of industrial investment in R&D is also evident in other policy instruments like R&D tax credits and innovation vouchers.

Maturity of innovation support systems: There is a clear contrast between the status of the innovation support systems in the 12 New Member States compared with the original EU15. The latter are primarily concerned with improving the integration and co-ordination of existing systems and structures. The innovation systems in the former are more embryonic and are being developed as part of the more fundamental economic transition in these countries.

Graduates: The supply of science and engineering graduates is clearly an important source of intellectual capacity for knowledge-based industries and attracting high-tech inward investment. Some countries have R&D programmes that use graduates as the central resource in collaborative projects between universities and industry. This can also be an effective means of overcoming barriers in companies that do not have sufficient absorptive capacity to engage in R&D projects. For example, the UK 'Knowledge Transfer Partnership (KTP)' programme has been operating for over 30 years and publishes annual statistics on direct impacts on participating companies in terms of increased jobs, profits and capital expenditure. In Denmark, the 'Industrial PhD Programme' has similar objectives but is also open to projects that link Danish companies with foreign universities. Some countries are so concerned about R&D skills gaps that they have introduced incentives that are aimed at attracting researchers from other countries (for example, China, Cyprus, Ireland and Hungary have programmes that encourage 'ex-pat' researchers to return to their native country).

Structural Funds: The use of EU Structural Funds to support the funding of national R&D programmes has quite an important influence on the programme design in countries that are the main recipients of such external funding. Multi-annual R&D framework programmes appear to be the most common model and these are sometimes designed for synergy with the EU RTD Framework Programme. Countries like Ireland and Spain have had such programmes for some time and both Hungary and Poland introduced R&D Frameworks for the 2007-13 period.

Of course, these variables cannot be considered in isolation as the relative mix may vary considerably between different countries. It is possible, however, to classify EU Member States into five basic types by considering key variables like economic scale, R&D intensity and maturity of innovation support structures. For example, members of the original EU15 generally have a mature science base, mature innovation support systems (including developed institutional structures for R&D), an established industrial base, a steady flow of graduates and a relatively high level of private sector R&D. This is in strong contrast with the New Member States, where the economic and innovation system maturity is much more embryonic. Within the two groups, there are distinct differences in the level of R&D investment and it is important to distinguish between the high and low R&D spending countries. The three largest countries (France, Germany and the UK) can also be considered as a distinct group of countries with similar economic scale and R&D intensity.

This gives us five main EU27 country categories, for a more detailed analysis of the situational strategies, as follows.

- EU15 Large - high – Large, R&D-intensive EU15 Member States: France, Germany and the UK

- EU15 Small - high – Smaller EU15 Member States with R&D investment as a percentage of GDP higher than 1.5%: Austria, Belgium, Denmark, Finland, Luxembourg, Netherlands and Sweden.
- EU15 low – EU15 Member States with R&D investment as a percentage of GDP less than 1.5%: Greece, Ireland, Italy, Portugal and Spain.
- NMS high – New Member States with R&D investment as a percentage of GDP greater than 0.75%: Czech Republic, Estonia, Hungary, Lithuania and Slovenia.
- NMS low – New Member States with R&D investment as a percentage of GDP less than 0.75%: Bulgaria, Cyprus, Latvia, Malta, Poland, Romania and Slovakia.

The following Table 12 shows the source and allocation of R&D investment in each of the five country categories. This highlights a relatively high level of experimental R&D in the medium/small EU15 countries (42-50%) and relatively low level of basic research in those that are more R&D intensive (only 18%). The latter countries also have a relatively high proportion of business expenditure on R&D (60%). This is in contrast with the New Member States and the less R&D intensive EU15 countries where public funded R&D dominates.

Table 12: Type of activity and sources of funding

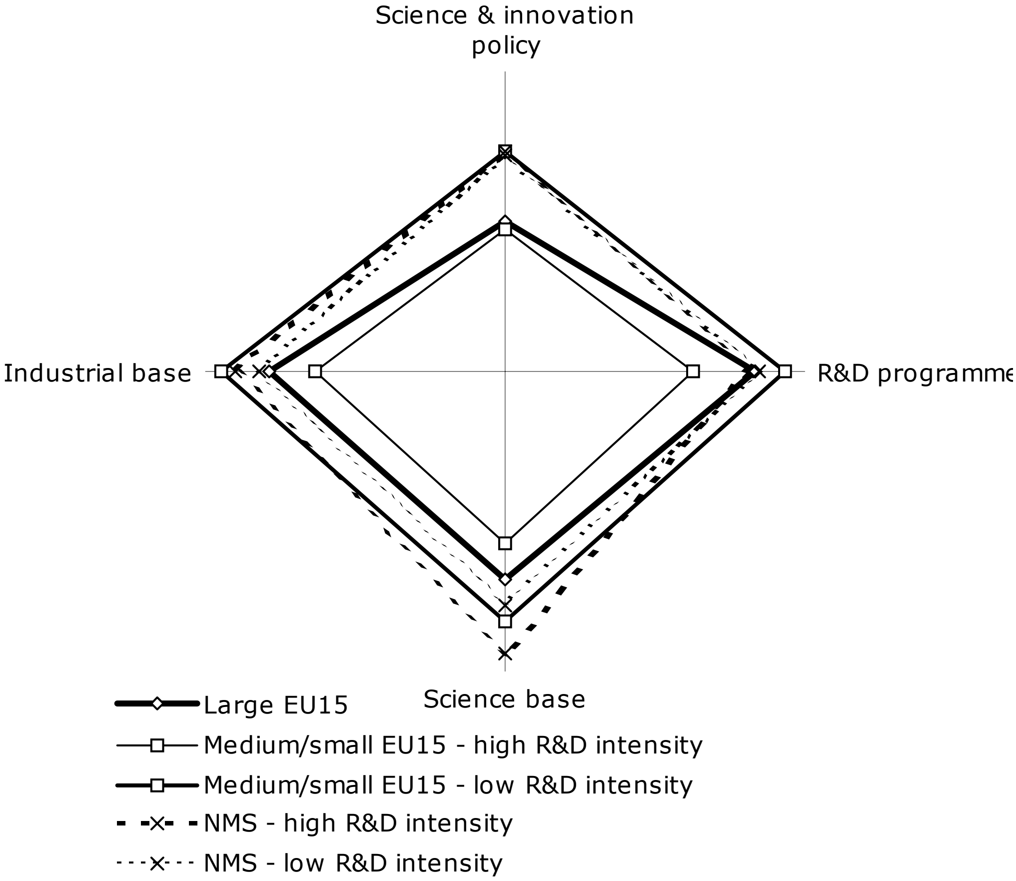
	Type of activity (%)			Source of funds (%)		
	Basic	Applied	Experi-mental	Busi-ness	Govern-ment	Other
EU15 Large - high R&D	29	42	29	54	32	14
EU15 Small – high R&D	18	33	50	60	28	11
EU15 low R&D	23	36	42	43	45	13
NMS – high R&D	30	35	36	38	50	12
NMS – low R&D	32	45	23	33	56	11

Source: R&D Expenditure in Europe, Eurostat, 2006.

Barriers in Different Types of Countries

Figure 10 shows the variation in the relative prevalence of the barriers for different types of countries. This is based on the four categories of barriers in Table 10 (science & innovation policy, R&D programmes, science base and industrial base). This shows that the barrier prevalence is lowest (in all four categories) for the smaller, R&D intensive EU15 countries. The difference is particularly noticeable in the ’R&D programmes’ category.

Figure 10: Prevalence of barriers in different types of countries



Source: ImpLore country reports and country expert survey.

More specific variations in relative prevalence were also highlighted on the level of specific barriers. These differences are summarised in Table 13 to Table 16, which highlight some quite interesting and [mostly] intuitive differences in prevalence between the five different EU country types.

Table 13 provides evidence of the progress that has been made in the three largest EU15 countries to improve the coordination between science & innovation policy and the various public sector organisations that implement these policies. The contrast between the two types of R&D-intensive EU15 countries (i.e. large vs. smaller) related to non-systematic approaches to innovation support appears surprising but may be related to the fragmented landscape in the large countries. The smaller countries tend to have a more integrated structure with a single innovation agency and research council. The relatively new Technology Strategy Board in the UK and OSEO in France would suggest that there is a desire in the large countries to be more coordinated and systematic.

Table 13: Relative prevalence of Science & Innovation Policy barriers

Science & Innovation Policy Barriers	*Most prevalent countries*	*Least prevalent countries*
Lack of an integrated science/innovation policy	NMS high R&D	EU15 large
Lack of effective coordination between R&D ministries and innovation agencies	NMS low R&D	EU15 large
Non-systemic approach to innovation support	EU15 large	EU small high R&D
National R&D spending is low	EU15 low R&D	EU high R&D (both)
National R&D spending is decreasing	NMS low	All others

Source: ImpLore country reports and country expert survey.

In Table 14 we again see the contrast between the large and smaller R&D intensive countries in the EU15 countries, and also between those that that have high and low R&D intensity. It also provides more insight into why the small, R&D intensive EU15 countries score so well in Figure 10 above. Barriers related to the governance aspects of R&D programmes appear to most prevalent in the New Member States.

Table 14: Relative prevalence of R&D Programme barriers

R&D Programme Barriers	*Most prevalent countries*	*Least prevalent countries*
Too many programmes/actions leading to complexity, diluted resources & bureaucracy	EU15 large	EU small high R&D
Creation of programmes without reference to/evaluation of past programmes	EU15 low R&D	EU high R&D (both)
Low level of SME-specific funding support in programmes	EU large	EU small high R&D
Lack of evaluation evidence on impact of R&D programmes	NMS high R&D	High prevalence in all
Lack of transparency in programme management and project evaluation funding	NMS low R&D	EU small high R&D

Source: ImpLore country reports and country expert survey.

Table 15 shows an interesting researcher capacity contrast between the more R&D-intensive New Member States and the three large EU15 countries. It also indicates that the R&D-intensive EU15 countries are making progress on overcoming the barriers to the exploitation of their science bases. The relative emphasis on basic research in the large EU15 countries is also clear from Table 7 and was quite prevalent in the R&D-intensive New Member States.

Table 15: Relative prevalence of Science Base barriers

Science Base Barriers	*Most prevalent countries*	*Least prevalent countries*
Poor links between science and industry	NMS high R&D	EU small high R&D
Focus on the development of basic rather than applied & experimental research	EU15 large	EU small high R&D
Lack of R&D capacity due to a shortage of researchers in the country (both public and private)	NMS high R&D	EU15 large
Lack of encouragement and support for the commercialisation of research	NMS (both)	EU15 high R&D (both)

Source: ImpLore country reports and country expert survey.

The prevalence of barriers in the EU15 countries with relatively low R&D intensity countries is quite prominent in Table 16. This appears to be consistent with the relatively low share of investment in R&D by the business sector (as shown earlier in Figure 2). This relatively low level of indigenous business expenditure in R&D is also apparent for the New Member States, including the more R&D intense where it appears that the large foreign-owned businesses may be more important to the industrial R&D activity. Again the smaller R&D intensive EU15 countries have a relatively low prevalence of industrial barriers.

Table 16: Relative prevalence of Industrial Base barriers

Industrial Base Barriers	*Most prevalent countries*	*Least prevalent countries*
Lack of innovative companies (R&D absorptive capacity)	EU15 low R&D	EU15 small high R&D
Majority of private R&D by small number of large/well established companies	NMS high R&D	EU15 low R&D
Low level of SME investment in (both public and private) R&D	EU15 low R&D	EU15 large
Shortage of R&D intensive companies that are able to participate in programmes	EU15 low R&D	EU15 low R&D
Lack of / insufficient structures and measures to encourage private sector R&D	NMS low R&D	EU15 small high R&D
Lack of support to develop absorptive capacity of firms	EU15 large	EU15 small high R&D

Source: ImpLore country reports and country expert survey.

Strategies in Different Types of Countries

Table 17 presents the 20 most prevalent strategies in order of their perceived impact on innovation (as shown in Table 11) and the relative prevalence across the five country groupings.

Table 17: Prevalence of Top 20 strategies in different types of country

Rank	Top 20 strategies in order of perceived impact on innovation	Rank of strategy prevalence				
		EU15 - large, high R&D	EU15 - small/ medium, high R&D	EU15 - low R&D	NMS - high R&D	NMS - low R&D
1	Development of a national innovation policy/strategy (integrated science/innovation policy)	13	5	2	13	7
2	Significant government & societal focus on and/or investment in innovation	10	10	9	4	3
3	Programmes that encourage / require links between science & industry	1	1	1	6	11
4	Support to encourage increased employment in R&D / make science careers attractive	17	12	13	20	13
5	Development and support of competence centres / centres of expertise / excellence	3	7	6	2	2
6	Definition of long term thematic priorities	5	13	17	7	1
7	Focus on increasing the exploitation of public R&D results by industry / SMEs	4	3	14	14	10
8	Development of innovation infrastructure - tech parks, incubators, tech transfer centres,	7	8	7	1	8
9	programme monitoring and evaluation leading to continual improvement	12	18	20	17	17
10	Use of thematic programmes	2	6	10	10	4
11	Fiscal incentives for R&D	18	14	3	3	16
12	Commitment to / promotion of international cooperation	20	15	19	5	5
13	Industry / SMEs encouraged to engage with the science base	15	16	4	18	12
14	Increasing use of competitive programmes (in place of institutional funding)	6	2	16	8	6
15	Support for commercialisation of research results achieved at public research institutions	8	11	15	19	15
16	Development of collaborative sectoral clusters/networks for R&D	9	20	5	15	9
17	Use of national / international experts to support programme design and/ or implementation	19	9	8	9	20
18	Coordinating structures for administration and funding of ST&I	14	17	12	11	18
19	Focus in increasing R&D expenditures of SMEs (share of R&D performed by SMEs)	16	4	11	16	14
20	Consolidation of programmes in a limited number of nationally important themes	11	19	18	12	19

Source: ImpLore country reports and country expert survey.

Several key observations that can be made from this analysis would include:

- The strategy ranked 3rd (R&D programmes that encourage links between science & industry) is the most prevalent in all of the EU15 countries. Not surprisingly, it is only 13th in the New Member States with relatively low R&D intensity (i.e. this strategy may not be so effective with a weak science base)
- The New Member States appear to be more focused on innovation infrastructure and developing centres of excellence. This seems logical as their innovation support systems and structures are more embryonic.
- The top ranked strategy (integration of science and innovation policies) appears to be a relatively high priority in the less R&D intensive EU15 countries. The lower prevalence in the three large countries is possibly because this strategy has has already been at least partly implemented (for example, the UK Technology Strategy Board, the German High Tech Strategy and the French pôles de compétitivité).
- The smaller and more R&D intensive EU15 countries appear to be focusing more the use of competitive R&D programmes instead of institutional funding (for example, for universities and research institutes).

3.2.3 Implications for publicly-funded research programmes

This chapter provides insights into the R&D-related barriers and strategies that are prevalent across the 27 EU Member States and their perceived impact on innovation. The analysis was based on the knowledge that had been gained by the ImpLore country experts who carried out the mapping of national research programmes in each country. More detailed cluster analysis of five country types highlighted significant differences between the relative prevalence and perceived importance of these barriers and strategies. This appears to confirm our original hypothesis that the most effective strategies for any country are dependent on its situation in terms of key variables like economic size, scientific intensity, industrial structure and maturity of innovation support systems. For example:

- ***The three largest EU15 countries*** have quite a fragmented research programme landscape involving many public sector ministries and agencies. They also invest much more in scientific capacity and basic/applied research than experimental R&D. The use of thematic programme strategies is quite prevalent and there is a strong emphasis on programmes that require links between science & industry. The latter strategy is also reinforced through the development of competence centres/networks.
- ***The smaller, R&D intensive EU15 countries (>1.5% of GDP)*** have more integrated research programme landscapes and focus their programmes on more experimental (closer-to-market) activities. These countries are also placing a strong emphasis on programmes that require science/industry links and moving towards best practices in programme management through the use of international experts and better monitoring/evaluation of projects. The use of competitive programmes is also quite prevalent as are fiscal incentives for R&D, support to increase SME spending on R&D and actions to increase R&D employment.

- ***The less R&D intensive EU15 countries*** tend to have more open research programmes and the proportion of public sector investment (compared with business) is generally higher than in the other EU15 countries. These countries are also focusing on improving science/industry links, using international experts and the development of sectoral clusters for R&D. There is also quite a high prevalence of policy level initiatives including a stronger national focus for innovation, national innovation strategies and coordination structures. Fiscal incentives for industrial R&D are also quite prevalent.

- ***The more R&D intensive New Member States (>0.75% of GDP)*** have the highest levels of inward investing companies from other EU Members States. As for the EU15 countries, there is a high prevalence of programmes that require links between science & industry and use of international experts. National innovation strategies are also apparent, including the development of innovation infrastructure and fiscal incentives for R&D.

- ***The less R&D intensive New Member States*** have the lowest proportion of % investment in R&D by business (only 33%). There is a high prevalence of collaborative sector clusters for R&D and a relative high prevalence of policy strategies including definition of long term R&D priorities and commitment to international cooperation. Development of innovation infrastructure and actions to increase R&D employment are also prevalent.

These are, of course, based on cluster averages and there can be quite significant differences between individual countries (and even regions) in the same typology group (for example for France, Germany and the UK). This analysis (based on collating the observations and perceptions of ImpLore country experts) has provided a wide range of insights into current policies and practices in the EU countries. It therefore provides an external comparison with the results from the survey of national stakeholders in the following sections.

3.3 The Specific Role of R&D programmes in the New Member States

The innovation systems in the New Member States have experienced major changes in the past two decades.

- The EU structural funds have played a major role in supporting R&D and innovation.
- The accession to the EU increased the countries' attractiveness for foreign capital, including investments in R&D.
- The growth and innovation oriented goals of the EU have been adopted by all New Member States.
- The base for policy-making has been improved since the New Member States had to adjust their statistics, accounting and reporting systems to EU standards.
- The New Member States are learning and copying best practice examples from other EU countries which continually improve their innovation systems. The design of most R&D programmes has thus emerged through international policy learning.
- R&D programmes, at least those programmes that are financed by the EU structural funds, have to be regularly evaluated.

In the New Member States (NMS) of the EU, the policy thinking on scientific research has changed significantly over the past two decades. The transition process that took place in these countries is responsible for a number of economic, social and political changes. Rapid and harsh reforms were launched, many of which were barely socially acceptable. Political action was focused on public deficits, price instability, and huge foreign debts. Against this background science and education issues seemed to fade away, at least in the first years of socio-economic transformation. Although changes were introduced in this area, they were, at least at the beginning, more of a reaction to certain problems than a deliberate plan. However, currently some complex and more structured reforms of the science system are being introduced in many NMS. The transition processes and implementation of the EU standards before accession have already brought some important changes in the national innovation systems of the NMS, which have also had some impact on design, management and evaluation of publicly-funded R&D programmes. It should, however, be pointed out that the transition processes of national innovation systems in the NMS are not yet complete. The countries are still undergoing a transformation process in the area of R&D policy support systems. Although the role of the state has already shifted from a top-down approach to a more liberal model there are still not sufficient linkages between all elements of innovation systems in NMS. Despite huge efforts and increased spending, the outcome of this process is still uncertain and the question still remains as to when these countries will be able to close the research and innovation gap between old and new EU members.

The main objective of this section is to analyse specific features of publicly-funded R&D programmes in the EU New Member States and to assess their impact on innovation.

These countries are treated as a separate group because their innovation systems differ significantly from the 'old' EU members. First, in all these countries national innovation systems have been transformed recently, however the transition processes have not been completed yet, which have significant consequences for design, management and evaluation of publicly-funded R&D programmes as well as for their impact on innovation. Second, in all NMS endogenously generated technology has played only a marginal role in their innovation performance so far. Foreign sources of new technologies were far more important. Moreover, very weak university-industry links and a lack of technological co-operation among enterprises made these countries specific as their innovation policies and publicly-funded R&D programmes are more focused on building linkages than on creating new knowledge. Furthermore, insufficient domestic R&D in NMS only partly offset by foreign R&D (transferred mainly through FDI) might imply that the impact of publicly-funded R&D on innovation will be not so clear due to the lack of critical mass in these countries. Therefore, innovation patterns are different in these countries than in 'old' EU members and some additional comments concerning factors that shape these specific patterns are needed.

Responsibilities in R&D policy in Poland

In Poland are two ministries responsible for creating publicly-funded programmes that promote R&D and innovation, viz. the Ministry of Science and Higher Education, which is in charge of the overall financing of scientific activities, and the Ministry of Economy, which focuses on innovation.

The Ministry of Science and Higher Education, apart from providing core funding for statutory R&D activities of universities and other research units as well as investment in R&D infrastructure, is responsible for the following programmes that have innovation among their objectives (mapped under ImpLore project): (1) National Framework Programme (2) Foresight Programme (3) Polish Optical Internet - Advanced Applications, Services and Technologies for Information Society Programme (4) Peer-reviewed research grants programme, (5) Subsidies for R&D projects of national importance, (6) Initiative supporting involvement in international R&D programmes. Other R&D programmes financed and run by this ministry are more focused on basic research, so their innovation impact can only be seen indirectly and in the long run.

The Ministry of Economy, the second governmental body in Poland involved in publicly funded programmes, mainly designs programmes promoting innovativeness, and to a lesser extent R&D. Such programmes mainly address enterprises and are co-funded by EU structural funds (for example, (1) Programme SPO-WKP 2004-2006, Subaction 2.2.1 Support for enterprises conducting new investment; (2) Law on financial support for investment of 2002). On the other hand, this ministry is also responsible for ownership transformation of R&D units (i.e. R&D performers), as well as cooperation with regional authorities in the field of innovation policy, collaboration with international organizations on innovativeness, and control over the patent office.

Such division of responsibilities between two ministries without any coordinating body is one of important factors limiting the impact of R&D programmes on innovation in Poland.

National innovation systems differ among NMS because each country has developed its own framework. However, some similarities can be identified. The main actors involved in outlining, designing, shaping and assessing R&D and innovation policies are the Ministries of Science and Technology, Ministries of Education, Higher Education (as defined in each state), Ministries of Economy as well as the Ministries of Finance to a smaller extent, as the funding body. The ongoing management usually rests in the hands of state agencies.

Considerable barriers to R&D and innovation development still exist in all six countries (Poland, the Czech Republic, Slovakia, Latvia, Lithuania, Estonia). They are mainly related to the turbulent transition period and to the acute reforms these countries had to undergo. Thus, these barriers reflect, to a certain degree, successes and failures which occurred while the countries' economies were transforming. Fortunately these hindrances and weaknesses are counterbalanced with new initiatives and policy measures acting as facilitators of innovation and economic development.

However, one of the main problems in the NMS seems to be insufficient coordination of R&D and innovation policy, which influences the whole process of creating publicly funded R&D programmes (their design, management, evaluation) and thus, limits their impact on innovation.

This is not the case in Estonia, however. As a positive development in this country, the Foundation of the Enterprise Estonia (Ettevõtluse Arendamise Sihtasutus, EAS) should be mentioned. The EAS was founded in 2000 through the merger of previously independent agencies (Estonian Trade Promotion Agency, Estonian Technology Agency, Estonian Tourist Board, Estonian Regional Development Agency). Since then, Enterprise Estonia is the main institution responsible for R&D policy in Estonia.

R&D funding in Estonia

In terms of the changes in how R&D programmes are funded, Estonia is a good example among the NMS. The total R&D budget in Estonia has increased considerably since 2004, a development that is related to the opening of EU Structural Funds. The total budget was about 120 million Estonian kroons in 2002, 263 million in 2004 and 214 million in 2006 (Reid et al. 2006). R&D expenditure as a share of GDP increased from 0.73 % in 2001 to 0.91 % in 2004; the share of private sector expenditures increased from 24% to 39% in total during the same period. While both grants and loans were used before 2004, in 2004 there was a switch to only grants to satisfy the needs of Structural Funds. Though the Structural Funds have made a considerable contribution to the financing of R&D policies, there are also problems connected to them: 1) there is a long delay in the application of Structural Funds due to bureaucracy, 2) it has not always been the case that Structural Funds are used as an additional support to national funds; instead funds often replaced the financing from the state budget (Knowledge Based Estonia 2007-2013).

The presumably most important challenge for all NMS is to increase R&D financing, which will help to implement science and technology policies by creating more publicly-funded as well as privately-funded R&D programmes. Public R&D expenditures are relatively low in the majority of these countries, below the average of the EU27 (0.65% of the GDP), ranging from 0.21% of GDI in Malta and 0.27% of GDP in Slovakia to 0.58% of GDP in Lithuania and 0.60% in Slovenia (EIS 2008, pp.51-52). The R&D and innovation landscape suffers mainly from insufficient funds allocated to these areas. However, various steps have been undertaken recently to address this barrier. All NMS have an increase in the ratio of R&D expenditures to GDP as the main goal in their innovation strategies. In Estonia for example, the policy document "The Knowledge-based Estonia 2007-2013" includes more quantitative targets than the previous policy documents. It sets a target for government R&D spending of 1.4% of GDP by 2013.

Furthermore, in the majority of the NMS, legal conditions stimulating R&D expenditures and innovative activities in the business sector have also been significantly improved (in Poland for instance, a 22% VAT for research services has been introduced, as well as the improvement of the status of the R&D centres that offer other fiscal incentives).

The funding issue is one side of the R&D programmes. The other is related to the institutions that conduct R&D. In some new EU countries, namely the Czech Republic and Slovakia, the former R&D system was mainly based on the Academies of Sciences and was thus similar to the former Soviet Union research support system model. In others, university research co-existed with publicly financed institutes and laboratories that conducted both basic and applied research activities. Currently the Academies of Science and public research institutes in most of the NMS are undergoing a process of transformation, consolidation and liquidation. The weakest R&D institutions are either consolidated with larger ones or shut down by the government. The process of transformation of these institutes was caused mainly by the reduction of spending on research by the state and the collapse of state owned companies who, in the past, were often clients of those institutions. Furthermore, universities are also undergoing a transition as the rules of their financing have been changing. In the past in the NMS the funding of the research was mainly based on public subsidies. Therefore, the links between research organizations and the business community were very weak. With a transformation of the innovation systems in the NMS a growing proportion of the funds has been provided on the basis of public tenders, but universities as well as the Academies of Science are still mainly publicly-funded, which does not create incentives to build relations with the industry.

Lithuania: recent reform

The Lithuanian system is inflexible in the sense that nearly all public resources in the existing public institutes are fixed. This kind of system is naturally inclined to resist any changes in priorities, division of resources, and ways of working. Cooperation and interaction between companies and research institutes or universities is modest and occasional. The same is true of cooperation and interaction between research institutes and universities. Recently efforts have been made to increase the impact of R&D and innovation policy. They have taken the form of:

- Greater coordination of innovation and R&D policy efforts via establishment of a Science, Technology and Innovation Commission in the government of Lithuania,
- Development of joint R&D programmes by the Ministry of Economy and Lithuanian Ministry of Science and Education (High technology development programme, 2003),
- Redesigning R&D funding models (ongoing), Increased competitive R&D funding.

In addition, the problems of creating a strong relationship between universities and the business community are often associated with the legal difficulties relating to the linkages between public and private partners in the NMS (for example in Poland there is no clear legal framework for creating spin-off firms). Furthermore, the majority of publicly-funded R&D programmes in NMS that have been introduced so far, do not require any co-funding or require very limited co-funding by programme users, or even a public-private partnership. Introducing a co-funding requirement should, on one hand, increase the interests of programme users to introduce improvements during all programme stages, i.e. designing, management, monitoring and evaluation, and on the other hand, should lead to higher efficiency and higher innovation impact. Public-private partnerships were problematic in the past because there were no regulations to govern them. However, recently there have been changes in this respect.

Poland: PPP

In Poland, a new legislation on Public-Private Partnership (PPP) was introduced to strengthen relations between public and private R&D. It came into force on 7 October 2005. Although the first step has been taken, there are still no regulations determining the requirements necessary for establishing PPP contracts.

Most of the new policies in the NMS aim at decreasing the role of institutional financing of R&D and give preference to project-specific support. Thus, the current programmes are oriented towards a more systemic approach to R&D support.

All in all, existing patterns of R&D Programmes in the NMS stress the urgent need for science/industry cooperation. The major weakness of R&D projects carried out by scientific institutions is that even though the results may be novel, they are very rarely implemented. Most of these innovative results very rarely reach a company or are not made available to the public and often end up forgotten in the scientific institution. In consequence, a lot of the innovation impact is lost and not used by the business community. In contrast to this, there are R&D programmes, which are performed by private companies, where the main goal is the implementation of R&D results. However, the impact of the innovation is here often very small as the programmes are more concentrated on companies' needs than on the novelty of the results. Therefore only programmes that are designed for a combination of scientific institutions with private companies are likely to have high innovation impact.

Latvia: LIDA

In Latvia, promoting private sector investment in applied research, technology transfer and assuring implementation of research results in the industry are core functions of the Latvian Investment and Development agency (LIDA). On the 1st of June 2006, a Technology Agency was established as a structural unit of LIDA. LIDA is involved in appropriately managing state support programmes. It also analyses the innovation system and investigates the efficiency of applied instruments, especially outside the capital of Latvia.

The transformation of the research support system in the NMS is aimed at encouraging networking between research and business communities. The rising awareness among policy makers concerning the importance of a science/industry relationship is visible in the programmes' design. The strengthening of science/industry collaboration is often mentioned in various programmes' objectives and some of the R&D programmes are designed for joint teams from research and business communities. This issue is also addressed in some countries on a policy level by creating special agencies responsible for facilitating industry-science relations (for Latvia- see box below).

The management of R&D programmes in the NMS is relatively weak and the strategies for its improvement have not yet been implemented. It should however be pointed out that the structures for programme management and administration have evolved from scratch, so their introduction is already an achievement. One of the main weaknesses is the overlapping of human resources in the programme design, implementation and impact assessment and lack of clear labour division (i.e. very often no department appears to be responsible for a given task or the same activities are run by more than one unit). Furthermore, the management is very bureaucratic. In the majority of NMS too much attention is paid to technical details in the selection process (application forms) and the formal programme monitoring (financial control and audit requirements). The quality of programme management is greatly influenced by the personal content (human resource quality) of the responsible bodies. A serious constraint is insufficient competencies among bodies involved in managing programmes. The lack of business experience among public officials is often mentioned as an obstacle to reaping a programme's full benefits.

So far, the management issue has not been addressed in the strategies of the NMS and no major developments in programme management have been observed. Also there have not been many changes directed at the improvement of the programme management.

Czech Republic: evaluation practice

In the Czech Republic a detailed methodology has been developed to evaluate both programme providers and project recipients. The evaluation is published annually by the Council of Research and Development. The results of the evaluation have been used in the selection process, particularly in institutional funding. However, the evaluation process is much more developed (at least formally) with regard to the operational programmes financed by the structural funds.

Furthermore, in the Czech Republic the results of the whole new policy towards the R&D support system will be evaluated. A National Innovation Policy has been in place since 2005. The aim is to strengthen the R&D support system and enhance the innovation effects. This policy will be evaluated on the basis of 48 measures that cover the responsibilities, deadlines and indicators of the implementation success of the programmes.

One of the weakest points of the R&D programmes in the NMS and the strategies to improve these programmes is the evaluation of results. The evaluation of project recipients is mostly concentrated on publishing outputs in a purely statistical form (even if in some countries the number of patents and new technology is counted). The particular methodologies for the evaluation of the programmes' impacts are not specified yet. The Czech Republic is the one exception in this respect (see box below). The majority of the NMS evaluation is limited to financial control and audit. The qualitative evaluation, taking into account more intangible impacts, seems to be rather disorganised. The methods for the assessment of long-term impacts on economic and social development are being currently introduced, so the results are not visible yet. No well-defined and transparent practices have existed so far in the NMS. There are, however, some attempts to introduce evaluation procedures in many of the NMS. In Estonia, the evaluation methodology is currently under development. In Poland, there is an on-going discussion concerning the necessity to implement evaluation procedures similar to those required in EU programmes. In Slovakia, the Ministry of Education declared a plan for establishing an advanced system of impact assessment. It will be based on exact output criteria. The final assessment is to be computed as a sum of weighted criteria and compared with the programmes' financial inputs.

Nevertheless, the application, evaluation and auditing systems in the NMS are now better structured than in the past. All the NMS have learned from the mistakes in the implementation of the EU Structural Funds 2004-2006, however the problem is that the outcome of the formal programmes is largely unknown. As a result, the evaluation system is still weak and no best practices or benchmarks exist.

An important step in the development of policy thinking in the NMS on public funding of research and assessment of innovation was the accession to the EU. The accession had impacts on the R&D support system designed in the transition countries. It induced new standards, increased the competition, and coverage of comparative data on EU research and innovation development. This in turn induced country policies which concentrated more on the evaluation of R&D inputs and its effects on the economy. As a result, the main policy in most countries is now focused on increasing the innovation effects of R&D programmes. The move toward the new policy aimed at improving R&D impact has also been encouraged to a large extent by EU public funds. The R&D public programmes were an important factor in speeding up the transformation process. Nevertheless, we observe that this system is still evolving and one of the results is a change in the structure of EU funds across transition countries.

In most NMS, the largest changes in the R&D support system had been undertaken for the implementation of the EU Structural Funds 2007-2013. In most NMS, the Structural Funds were the main motivation for the analysis of their current R&D situation and its impact on the economy. The results of these analyses are reflected in the national strategies and in the operational programmes, which emphasise the weaknesses of the countries in innovation. Thus, in all the countries, the new Operational Programme 2007-2013 provides public support for R&D activities. These programmes are mainly targeted at universities and other research units. The planned outcome of these programmes is to increase innovation output and support its transfer to business communities. In this sense, one of the consequences of the Structural Funds was a change in the attitude of the government toward research activities. In addition, the programmes designed for the coming period 2007-2013 are more concentrated on R&D support and innovation. Furthermore, the measures of R&D and innovation are better harmonized with those of entrepreneurship. These measures now have more quantitative targets, which allow for a better assessment of the effects of the programmes.

The new EU Structural Funds aim at encouraging the funding of larger research projects. The idea behind such a structure of public programmes is the assumption that larger R&D projects may lead to higher levels of innovation and the output will provide more benefits to the business community in the long run. As a result of the structuring of the EU programmes, a consolidation of research units and creation of research networks is encouraged, which may reduce the fragmentation of the research across institutions and countries.

Nevertheless, there are still some problems to address. In many cases the objectives of R&D programmes are too broad and the targets are defined rather vaguely. For a large number of programmes the objectives overlap, which may cause difficulties in understanding the aim of the programme and the expected outcome. However, on one hand, all the programmes encourage public and private partnership, yet on the other hand the administrative burden is often discouraging for the local entrepreneurs.

However, one type of problem observed in all the countries is difficulties in the implementation phase. The main changes to the EU Structural Funds aimed to simplify procedures and break down administrative barriers. In some cases the evaluation process of the R&D programmes is still not quite transparent. As a consequence, despite ambitious goals and targets set by the government for the new EU Structural Funds, the results may be rather weak.

The problem of weak enforcement of the programs may lie in how the programmes are assessed. The former programs have not been fully evaluated. In addition, the countries have only been building a clear assessment methodology for the results and the impact on innovation. Finally, the countries rarely use any benchmarks or good practice studies in their programmes to present the expected outcome/impact. Since the goals of the programmes are rather qualitative the results will be hard to evaluate. Therefore, one of the major changes of the R&D programmes in NMS should be setting the targets based on experience and evaluating the results based on the comparison to benchmarks.

Finally, stimulated by providing national co-funding to EU Structural Funds activities, the spending on public domestic funding for R&D programmes has increased in recent years. The gradual increase started in 2004. Nevertheless, the level of R&D expenditures is still very far from the Barcelona target. The level of funding is low in all the NMS, which leads to a degradation of the research base and as a result existing human capital cannot be efficiently used.

Summing up, the EU Structural Funds have played a paramount role in supporting R&D and innovation in the NMS. For a deeper insight into the role of the EU in R&D and innovative systems, the following aspects are worth mentioning:

- EU Funds, as mentioned, allow for a formidable injection of desperately sought-after money.
- EU accession increases a transition country's attractiveness for foreign capital, including investment in R&D activity.
- EU Strategies and goals have been adopted by all New Member States. This entails acceptance of so the called Barcelona Target, Lisbon Strategy etc.
- Since joining the EU new countries have had to adjust their statistics, accounting and reporting systems in compliance with those applied in the EU. Thus, more adequate, precise and updated facts and figures are available thanks to ERAWATCH, TrendChart, etc.
- Learning from other EU countries as far as R&D and innovation systems is concerned (including EU Framework programmes) can be seen in all NMS.
- The design of most programmes in the NMS has emerged through international policy learning (examples of the EU practices, in particular EU Framework programmes).

- Requirements concerning evaluation have been introduced (in particular for programmes financed by the EU Structural Funds).
- All the NMS have learned from the mistakes in the implementation of the EU Structural Funds 2004-2006 and improved their design, management and evaluation of programmes for the next financing period (2007-2013).

4 IMPACT OF R&D PROGRAMMES ON INNOVATION

4.1 Design features and programme impacts: Mapping of R&D programmes

This section analysis the relation between design features of R&D programmes and the impacts (as perceived by programme managers). Based on factor analyses, programmes' programmes are classified according to

- their key objectives (science vs. business orientation),
- the type of R&D and innovation activity funded (knowledge creation vs. knowledge diffusion) and
- the collaboration requirements (industry vs. science collaboration).

The relation between types of programmes to types of impacts (increased innovativeness, enhanced competitiveness, knowledge production) show that

- business sector oriented programmes tend to produce more direct innovation impacts;
- surprisingly knowledge creation programmes more often generate direct innovation impacts that knowledge diffusion programmes do;
- programmes demanding industry collaboration are more likely to show innovation impacts while mandatory science collaboration fosters knowledge creation.

The objective of this section is to relate different design features of R&D programmes to innovation impact. Thus, the information in the programme database is used to categorise R&D programmes with regard to different design features. These design features are then related to different types of innovation impacts. Methodologically, the analysis builds upon a blueprint for mapping R&D programmes which has been developed in the InnoImpact project. Empirically, it rests on the database of R&D programmes which was established in this study (see section 3.1) as well as on country reports and a survey of country experts.

The presentation takes into account several dimensions with regard to characteristics of R&D programmes in Europe. Empirically, the analysis rests on the programme database of the ImpLore project which was exploited with the help of quantitative methods. In particular, a factor analytic approach was chosen in order to extract the most important features of European R&D programmes and to show the similarities and differences with respect to programme characteristics and expected impacts. The impacts with respect to R&D programmes were assessed through a survey of programme managers.

To synthesise the large set of data provided in the programme database, a factor analysis was performed. In order to test whether a factor analysis is feasible with the variables, tests of sample adequacy of Kaiser-Meyer-Olkin were conducted. The test results show that factor analysis can be used to bundle the variables in question. The extraction method was the principal components method. Factor analysis is a relatively effective way of detecting common factors behind a large number of variables. The principal component factor analysis is built around the basic idea of exploiting correlations between several variables.[11] Based on these quantifiable interactions between variables, common underlying drivers (so called factors) can be extracted. Graphically speaking, these factors represent vectors aiming in certain directions. Each vector summarises the statistical content of all the variables that it includes. The outcomes of the mapping exercise provide valuable insights into major programme similarities, differences and interactions. They set the stage for the development of subsequent linkages with innovation performance.

An important step is the selection of an appropriate number of factors. Obviously, choosing as many factors as variables fully represents the dataset. Then again, for analytical reasons, selecting as few factors as possible is preferable. Therefore, an optimised solution is required that combines comprehensive representation of the data with one that can be meaningfully interpreted. We use the so-called Kaiser-criteria to strike this balance. It rests upon the variance contribution of one particular factor with regard to the variance of all variables (this relation is referred to as eigenvalue). Eigenvalues larger than 1 indicate a suitable factor. Once this choice of the number of factors has been established, the variance representation can be optimised through the "rotation" of factors (more precisely, we use varimax rotations). This step concludes the factor extraction phase.

The factors are the result of existing patterns in the data and not normatively influenced. Therefore, they have to be interpreted based upon how important certain variables are for constituting a certain factor. In other words, each variable has a certain weight (represented through the factor loadings matrix) for a factor, and these weights characterise its contextual nature. Based upon these findings, factor values can be calculated for each observation that serve as index values of a particular factor. These indices provide ordinal information, i.e. their absolute values contain no meaningful information only the differences between them. We rescale these indices between 0 and 1 for easier interpretation. These indices can be summarised, compared and interpreted as purposefully condensed information from several variables. This factor-analytical approach is, therefore primarily used as a tool for reducing the dimensions of complex information.

The following sections cover this procedure for several important project constructs and variables for all EU-27 states. We use the obtained information to relate factors of design characteristics to their expected impacts.

4.1.1 General Design of R&D Programmes

National R&D programmes typically evolve from a certain R&D roadmap that has been constituted by the nation states. The different types of possible R&D programmes form the R&D landscape of a country, and depending on the focus of these R&D programmes, national R&D strength can be built in certain technology fields. We start this mapping

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[11] For a detailed methodological description see for example Backhaus et al. (2000).

exercise by investigating the basic characteristics of R&D programmes. These are primarily the intended goals of a programme and the group of organisations or projects that are considered eligible for being carried out. The latter is of special importance as particular combinations of different project participants (collaborations) may be considered especially effective because of complementarities between their organisational, physical or knowledge assets.

Objectives of R&D Programmes

The objectives of R&D programmes are an obvious starting point. They can be direct or indirect in nature. The latter implies the establishment of innovation potentials as a basis for subsequent exploitation. The former is built around the idea of existing potentials and of how to translate them most effectively and efficiently into innovation outputs. We suspect that both patterns can be identified inside the data on programme objectives and eligibility.

With regard to programme objectives, we analyse a broad set of potential goals:

- Support industrial innovation
- Develop knowledge-based industries
- Improve scientific knowledge
- Exploit scientific knowledge
- Address social/environmental challenges
- Increase internationalisation
- Develop industry/science relations

We conduct a principal component factor analysis for 400 different programmes and identify two different factors (with eigenvalues larger than 1) driving the variables presented above. Table 18 shows eigenvalues and factor loadings after varimax rotation.

Table 18: Classifying R&D programmes by their objectives – results of a factor analysis

	Factor 1	*Factor 2*
Eigenvalues	1.70	1.30
Support industrial innovation	-0.11	**0.38**
Develop knowledge-based industries	0.14	**0.60**
Improve scientific knowledge	**0.69**	-0.17
Exploit scientific knowledge	**0.75**	0.20
Address social/environmental challenges	**0.43**	-0.22
Increase internationalisation	0.34	**0.57**
Develop industry/science relations	**0.43**	0.15
Factor Interpretation	Science Orientation	Business Orientation

Kaiser-Meyer-Olkin measure of sampling adequacy: 0.58.

Source: Own calculations based on ImpLore programme database.

As expected, we retain two factors which illuminate the previously outlined idea of two major streams in programme objectives. Factor loadings can be interpreted as the weight a particular variable has for the derivation of a factor. Factor 1 (science orientation) is primarily driven by the improvement but also the exploitation of scientific knowledge. Factor 2 (business orientation) is mostly driven by the development of knowledge industries and the support for internationalisation. In that sense, programme objectives appear to be already streamlined for a particular target group (science and businesses). We will further explore this finding with regard to programme eligibility.

Types of R&D and innovation activity

Beyond this layer of eligible organisations exists a layer of eligible projects that would be expected to correspond with the previous discussion of programme objectives and target groups. We investigate these patterns for a broad set of potential project types from basic research to innovation and, therefore, investigate the following variables:

- Basic research
- Applied research
- Experimental development
- Industrial design
- Knowledge- and technology transfer
- Dissemination
- Innovation

We conduct a principal component factor analysis for 425 different programmes and identify two different factors (with eigenvalues larger than 1) driving the variables presented above. Table 19 shows eigenvalues and factor loadings after varimax rotation.

Table 19: Classifying R&D programmes by the type of R&D and innovation activity supported – results of factor analysis

	Factor 1	*Factor 2*
Eigenvalues	2.17	1.43
Basic research	-0.15	**0.68**
Applied research	0.01	**0.80**
Experimental development	0.38	**0.60**
Industrial design	**0.48**	0.40
Knowledge- and technology transfer	**0.71**	-0.08
Dissemination	**0.73**	0.05
Innovation	**0.74**	0.04
Factor Interpretation	Knowledge Diffusion	Knowledge Creation

Kaiser-Meyer-Olkin measure of sampling adequacy: 0.67.
Source: Own calculations based on ImpLore programme database.

At this point of the analysis we find the initially outlined dichotomy between programmes that propel the creation of knowledge and the ones supporting its diffusion and exploitation. In the factor analysis we discover two factors. Factor 1 is mainly defined by innovation and dissemination of knowledge as well as by knowledge and technology transfer and industrial design. We subsume all these variables under the specification of knowledge diffusion. On the contrary, for Factor 2 the high factor loadings concentrate more on areas that we concluded as fields of knowledge creation, such as basic and applied research as well as experimental development.

Collaboration requirements

The benefits of collaboration are predominantly built around human and organisational interactions. Social networks arise that facilitate knowledge flows. What is more, this social capital enables the transfer of complex and tacit knowledge which may prove particularly relevant for subsequent economic success. Besides, combining knowledge from different partners provides opportunities for enhanced innovativeness. Then again, these exchanges may incorporate considerable transaction costs for the selection, initiation, implementation and exploitation among collaboration partners. Therefore, certain types of collaborations as part of the R&D programmes may be more fruitful than others.

We investigate common factors behind a variety of possible variables that are related tot the types of collaboration:

- Science/industry
- Industry/industry
- Science/science
- Science/administration
- Collaboration with SMEs

We conduct a principal component factor analysis for 413 different programmes and identify two different factors (with eigenvalues larger than 1) driving the variables presented above. Table 20 shows eigenvalues and factor loadings after varimax rotation.

Table 20: Classifying R&D programmes by collaboration requirements – Factor analysis

	Factor 1	*Factor 2*
Eigenvalues	1.55	1.27
Science/industry	**0.73**	0.19
Industry/industry	**0.70**	-0.35
Science/science	0.01	**0.77**
Science/administration	0.09	**0.73**
Collaboration with SMEs	**0.70**	0.17
Factor Interpretation	Industry Collaboration	Science Collaboration

Kaiser-Meyer-Olkin measure of sampling adequacy: 0.56.

Source: Own calculations based on ImpLore programme database.

Factor 1 is characterised by programmes that encourage industry linkages (high loadings for science/industry, industry/industry and collaboration with SMEs). Factor 2, though, is largely determined by the promotion of intra-science and science/administration collaborations.

4.1.2 Impacts of R&D Programmes

In order to relate the design features of R&D programmes to their perceived innovation impacts, the responses from the survey of programme managers were used to condense the different impacts using factor analysis. The impacts used to assess the R&D programmes are, therefore, impacts as perceived by the programme managers. The questionnaire addressed to programme managers included 14 different impact variables and the programme managers were asked to provide an estimation of the extent to which particular impacts are achieved with the programme. Some of the variables measure similar underlying phenomena and can therefore be grouped together. The factor analysis summarised the impact variables and resulted in three broader factors that measure impact.

Table 21: Impact of R&D programmes - Factor analysis

	Factor 1	*Factor 2*	*Factor 3*
Eigenvalues	6.60	1.65	1.33
The production of 'tangible' knowledge outputs , for example, publications, PhDs, new tools and techniques etc.	-0.02	-0.03	**0.90**
The production of 'intangible' knowledge outputs for example, enhanced knowledge bases, improved skills and capabilities etc.	0.21	0.16	**0.79**
Patents, licences, copyrights and other IPR	**0.52**	0.19	0.36
New or improved products	**0.90**	0.25	0.08
New or improved processes	**0.85**	0.27	0.10
New or improved services	**0.83**	0.23	0.05
New or improved standards, regulations or policies	0.15	**0.58**	0.24
New start-up companies or spin-offs	**0.56**	0.21	0.32
Improved innovation performance amongst participants	**0.65**	0.36	0.16
Improved innovation performance of the economy at large	0.36	**0.75**	0.04
Improved turnover, profitability and market sales of participants	**0.65**	**0.52**	-0.11
Improved turnover, profitability and market sales within the economy at large	0.40	**0.82**	-0.06
Enhanced competitiveness of participants	0.24	**0.69**	0.30
Enhanced competitiveness of the economy at large	0.19	**0.92**	0.07
Factor interpretation	Increased innovativeness	Enhanced competitiveness, standards	Knowledge production

Kaiser-Meyer-Olkin measure of sampling adequacy: 0.85.
Source: Own calculations based on ImpLore survey of programme managers.

The first factor summarizes particularly those impact variables that are associated with innovation in a more narrow and direct way, such as patents, new products, new processes, new services, start-ups, improved innovation performance and improved turnover. The factor can, therefore, be interpreted as including those impact categories that are associated with increased innovativeness. Those are also the innovation impacts that are quite easy to assess and measure. The second factor is associated with impact variables which are more related to impacts on the larger economy and the competitiveness of the programme participants, such as new standards and regulations, improved innovation performance of the larger economy, improved turnover within the economy at large, enhanced competitiveness of the economy at large and of programme participants. Thus, this factor can be called enhanced competitiveness and standards. The third factor summarises those impact variables that are linked to rather indirect innovation impacts and knowledge outputs which include tangible as well as intangible knowledge outputs. The R&D programmes that are linked to these impact categories produce knowledge in the form of, for instance, PhDs and capabilities. This factor can be called knowledge production. The factor analysis links all R&D programmes in the programme database to particular impact factors. Although, R&D programmes frequently lead to a broad range of impacts, the survey of programme managers has shown that basically each R&D programme can be linked to a particular type of impact.

4.1.3 The Relation between Design Features and Impact of R&D Programmes

The factor analysis of the design features of R&D programmes resulted in six factors that can be used to characterise R&D programmes across Europe. These design factors are related to the three impact factors that characterise the impact of R&D programmes as shown in Table 22. This analysis shows how programmes that possess a certain type of design feature may contribute more or less to a particular type of impact. Table 22 also indicates that programmes often support a broad range of impacts. The percentages show the share of programme managers that link a certain type of design features with a particular type of impact. For instance, about 26% of the programme managers are of the opinion that programmes with a science orientation lead to increased innovativeness. 35% of the programme managers think that these programmes lead to enhanced economic performance, whereas 39% of the respondents claim that science-oriented programme results in knowledge production.

The main objectives of programmes with a focus on science orientation are to improve and exploit scientific knowledge and to develop industry/science relations. The impacts which can be expected from these programmes are related to knowledge production and enhanced economic performance and standards. R&D programmes that have a business orientation tend to be more related to increased competitiveness than programmes oriented on scientific knowledge. One can thus conclude that programmes that support industrial innovation, develop knowledge-based industries and increase internationalisation mainly lead to rather direct innovation impacts, such as patents, new products, new processes, new services, start-ups or improved turnover whereas programmes that have the primary objective to support the production of scientific knowledge lead to rather general knowledge outputs in the form of capabilities or PhDs for instance.

Table 22: The relation between design features and impacts

Impacts	Design features: Science Orientation	Business Orientation	Knowledge Diffusion	Knowledge Creation	Industry Collaboration	Science Collaboration
Increased Innovativeness	26%	46%	34%	41%	51%	26%
Enhanced Economic Performance, Standards	35%	24%	30%	28%	22%	35%
Knowledge Production	39%	30%	36%	32%	27%	39%

Source: Own calculations based on ImpLore programme database and survey of programme managers.

R&D programmes that particularly address knowledge diffusion mainly generate impacts associated with knowledge production. This means that programmes that fund industrial design, knowledge and technology transfer, dissemination and innovation projects are mainly responsible for tangible and intangible knowledge outputs. R&D programmes that predominantly support knowledge creation in the form of basic research, applied research and experimental development mainly lead to impacts associated with increased innovativeness, i.e. rather direct forms of innovation impacts. The majority of programme managers (51%) report that R&D programmes that support industry collaboration produce increased innovativeness. Thus, programmes that have a clear focus on industry collaboration can also be expected to generate rather direct innovation impacts in the form of new products, processes etc. In contrast, those R&D programmes that mainly support science collaborations have the tendency to cause rather indirect impacts related to tangible and intangible knowledge outputs. Thus, the comparison of R&D programmes with regard to collaboration indicates that those programmes that favour industry collaboration initiate more direct innovation impacts whereas those programmes that support mainly science collaboration mainly initiate indirect impacts.

4.2 Impact on Innovation: Findings from a Survey of Programme Managers

A survey of managers of public R&D programmes run by EU member states shows that:

- R&D programmes do not only generate direct impacts to the participants but also indirect impacts that are beneficial to the surrounding society. Therefore, R&D programmes generate rather large spillover effects.
- R&D programmes frequently have an impact on "soft" factors such as knowledge capabilities, research performance and networking.
- Intangible and tangible outputs are the most frequent forms of specific impacts stemming from R&D programmes. Intangible knowledge outputs are enhanced knowledge bases, improved skills and capabilities whereas tangible knowledge outputs include publications, PhDs, new tools and techniques.
- In general, R&D programmes lead to increased innovation performance and competitiveness of participants as well as more direct impacts such as new or improved products and services.
- R&D programmes that have a strong innovation-related rationale also have a high innovation impact.
- Collaboration, in particular science/industry collaboration, has a strong impact on innovation.
- R&D programmes that favour projects with high innovation potential as well as scientific excellence lead to high innovation impacts.
- Both the size of the budget and the duration of the R&D programme have a positive impact on innovation.
- Private co-funding tends to have a positive impact on innovation.
- The existence of monitoring and evaluation mechanisms impacts positively on innovation.

In order to assess innovation impacts, the programme managers in Europe were asked to fill in a questionnaire. The purpose of the survey was to assess the impacts of R&D programmes. R&D programme managers were asked about a large number of potential innovation impacts and whether they were realised with respect to the programmes they were responsible for. In addition, the programme managers were asked about the innovation impacts of different design, management, evaluation features and strategies to improve innovation impacts.

In general, it is difficult to assess the innovation impacts of R&D programmes since not all programmes are evaluated regularly and different methodologies are used in evaluating R&D programmes. Therefore, even if programmes assess innovation impacts, the results are not comparable across all EU countries. A survey of programme managers helps to partly solve this problem since the results from the survey are comparable and the programme managers are regarded as the experts who possess information about innovation impacts of their particular programmes. However, an obvious shortcoming of asking the programme managers is that they are likely to be biased since they may not be willing to provide negative information about their programme. The result could be an overestimation of innovation impacts. In order to overcome this shortcoming, additional focus groups were conducted to get a more balanced view on innovation impacts of R&D programmes. All programme managers from the programmes that covered in the ImpLore R&D programme database (431 programmes) received an invitation to participate in the survey. Detailed responses are available for 173 R&D programmes. The respondents were asked to apply a rating scale from very high to very low. In addition, they had the possibility to point out "do not know" and "not applicable". Questions related to innovation impact were related to four different types of impact:

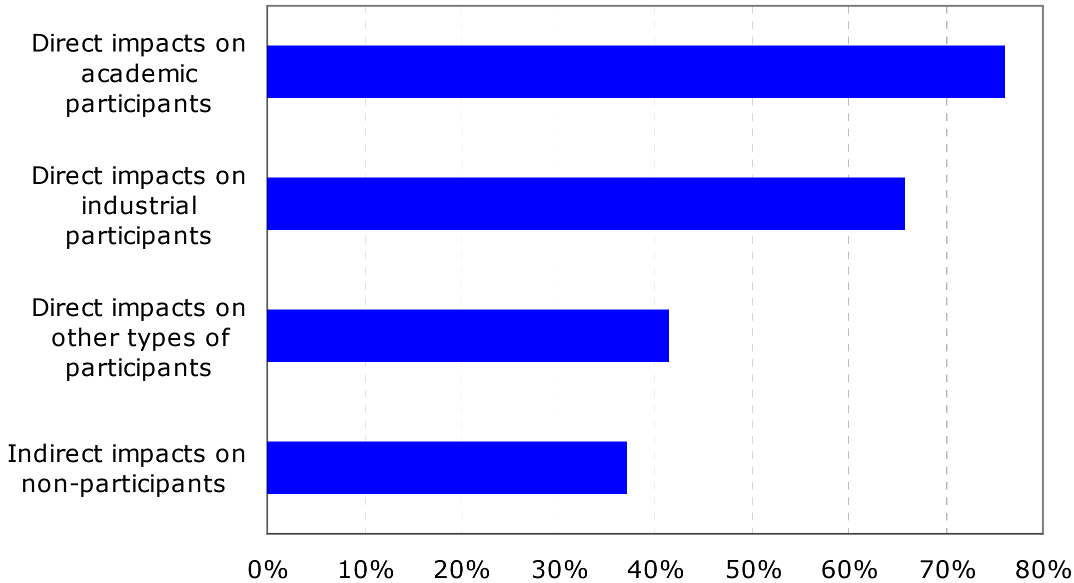
- Impacts on participants and non-participants,
- Impacts on scientific and industrial domains,
- Direct and indirect impacts on knowledge, networking and innovation,
- Specific types of impact.

4.2.1 Programme Impacts

The results with regard to impacts on participants and non-participants are provided in table below. The survey results show that direct impacts are mainly concentrated on the academic and the industrial participants. As one might expect, impacts are concentrated on the participants of R&D programmes, nevertheless, a rather surprisingly large share of indirect impacts on non-participants was reported by the programme managers. This suggests that R&D programmes create significant spillovers.

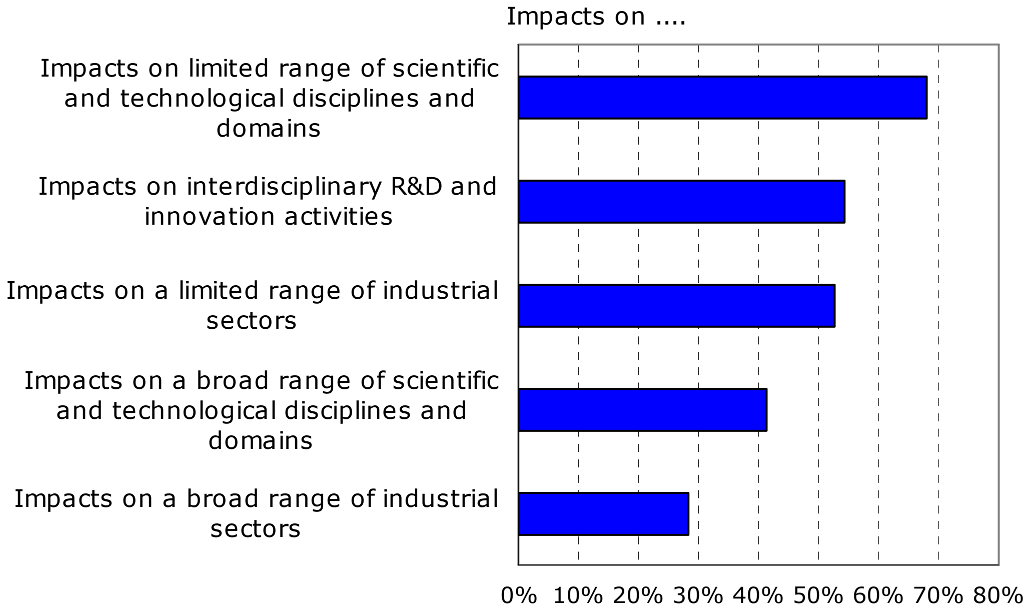
The survey results suggest that impacts are rather focused on particular scientific and technological domains and disciplines. Furthermore, impacts are focused on interdisciplinary R&D and innovation activities and for a limited range of industrial sectors. However, the programme managers report that broader impacts play a significant role. Although impacts are concentrated on a limited range of scientific and technological disciplines, spillovers to surrounding scientific and technological domains exist.

Figure 11: Impacts of R&D programmes on participants and non-participants as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

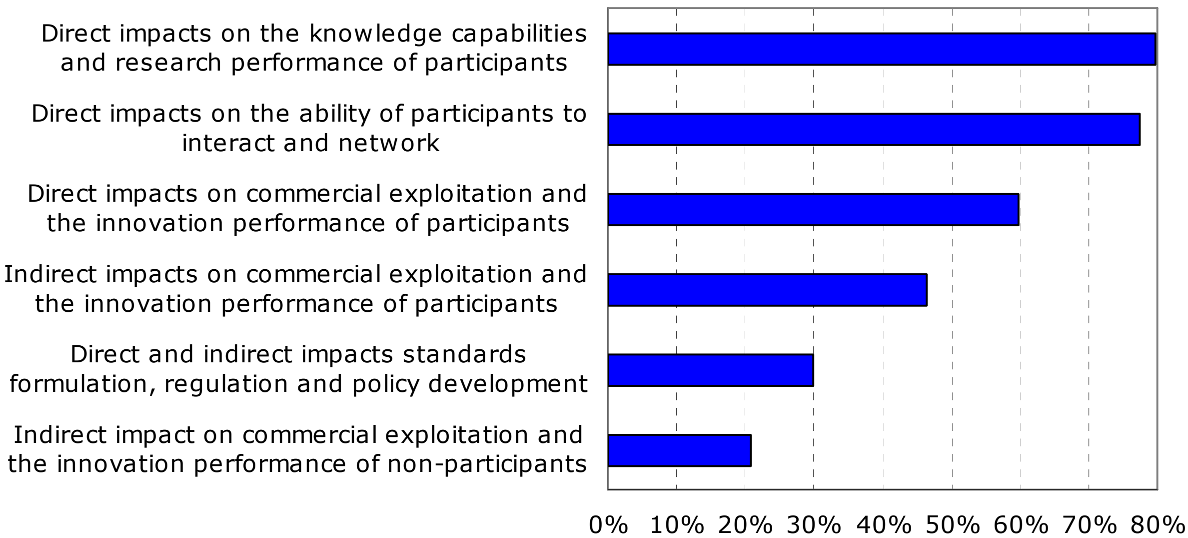
Figure 12: Impacts of R&D programmes on scientific and industrial domains as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

The main impacts of R&D programmes are direct impacts on the knowledge capabilities and research performance of participants. Furthermore, R&D programmes impact on the ability of participants to interact and network to a considerable extent. This result is interesting since theoretical literature, in particular the literature related to innovation systems (see for example, Lundvall 1992, Edquist 1997), points out that interaction and networking is a prerequisite for innovation. Nevertheless, the sister study InnoImpact has found out that projects aiming at networking seem less successful in terms of generating new knowledge. Those categories of impact are closely related to "soft" and interactive processes that are highly relevant in order to produce and develop innovations. However, the results show that even the direct impacts on commercial exploitation and the innovation performance of participants can be considered quite high. Figure 13 points to very similar facts as the previous figures since indirect impacts on non-participants were regarded as quite high. Thus, programme managers are convinced that R&D programmes have a number of impacts not only on participants but on non-participants as well.

Figure 13: Direct and indirect impacts of R&D programmes on knowledge, networking and innovation as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

Table 23 shows the specific types of impact that are associated with R&D programmes in Europe. Intangible and tangible knowledge outputs are the most frequent forms of specific impacts stemming from R&D programmes. Intangible knowledge outputs are enhanced knowledge bases, improved skills and capabilities, whereas tangible knowledge outputs include publications, PhDs, new tools and techniques. In general, R&D programmes lead to increased innovation performance and competitiveness of participants as well as more direct impacts such as new or improved products and services. Almost one third of all respondents think that R&D programmes foster the establishment of start-ups and spin-offs which is quite a high number especially taking into account the fact that the majority of programmes do not explicitly address the formation of start-ups. Again, indirect effects such as enhanced competitiveness of the economy and an improved turnover of the economy are regarded as being a quite frequent impact of R&D programmes in Europe.

Table 23: Types of impacts of R&D programmes as perceived by programme managers

	Share high/very high
"Tangible" knowledge outputs	74%
"Intangible" knowledge outputs	78%
Patents, licenses, copyright, other IPR	44%
New or improved products	65%
New or improved processes	67%
New or improved services	57%
New or improved standards, regulations or policies	27%
New start-up companies or spin-offs	32%
Improved innovation performance of participants	69%
Improved innovation performance of the economy	24%
Improved turnover participants	38%
Improved turnover economy	16%
Enhanced competitiveness of participants	65%
Enhanced competitiveness economy	25%

Source: Survey of R&D programme managers.

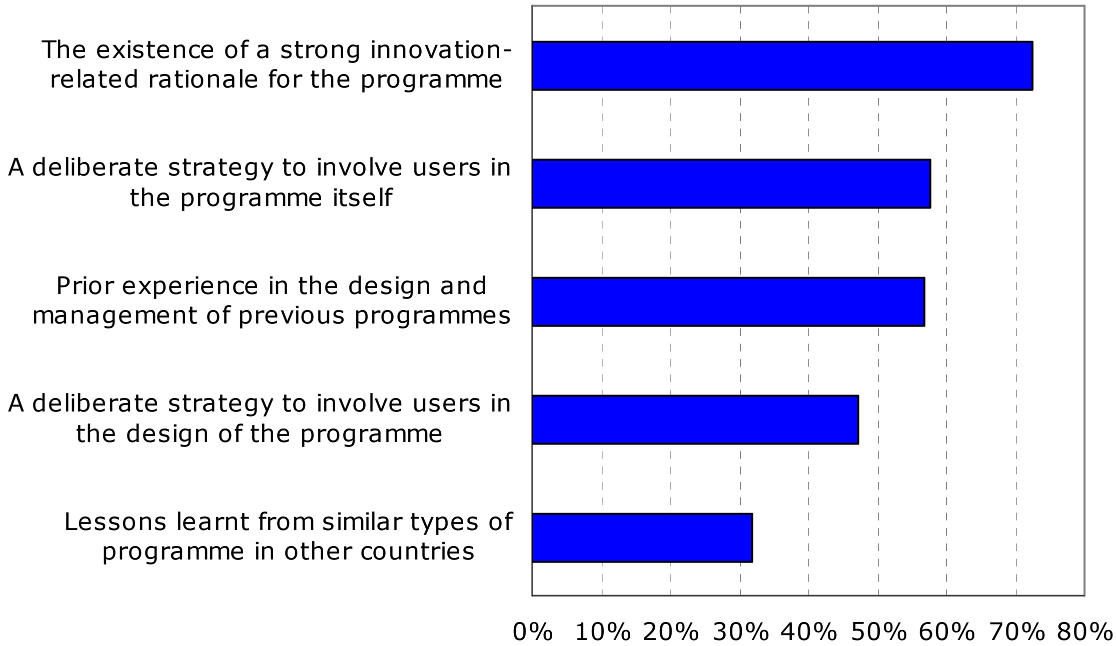
In sum, the survey of programme managers in Europe has shown that although direct impacts on academic and industrial participants dominate, a rather large share of programme managers is convinced that R&D programmes lead to a number of indirect impacts important for the whole economy. The results indicate that direct impacts on "soft" skills and factors such as knowledge capabilities, research performance and networking are the most frequent impacts from R&D programmes. Tangible and intangible knowledge outputs are important impacts from R&D programmes, however, even indirect effects on the economy at large such as increased competitiveness and increased turnover of the economy are considered important as well. These results are interesting since they suggest relatively large spillover effects to the wider economy from publicly-funded R&D programmes.

4.2.2 The Link between Programme Characteristics and Innovation Impact

Programme managers were asked to indicate the link between the design, management and evaluation features of R&D programmes and innovation impacts.

Here we show that the history and evolution of a R&D programme certainly matters for innovation. The natural starting-point is the existence of a strong innovation-related rationale, which is perceived to have a high innovation impact. R&D programmes that have strong objectives related to innovation right from the outset also lead to high innovation impact. This result at the programme level is related to the project level as well. This was shown by the InnoImpact study which found that project participants who did not have commercial/innovation goals at the start of the project were very unlikely to achieve commercialisation. The consequence is that R&D programmes with strong innovation objectives attract participants that aim at commercialisation. This, in turn, increases the likelihood of successful commercialisation and innovation. Experience with the design and management of R&D programmes is highly valuable. Although this result is essentially unsurprising, it has implications in particular for countries that delegate programme management to intermediaries such as programme management agencies (for example, in Germany). The involvement of users in the programme itself is also perceived as having a positive impact on innovation.

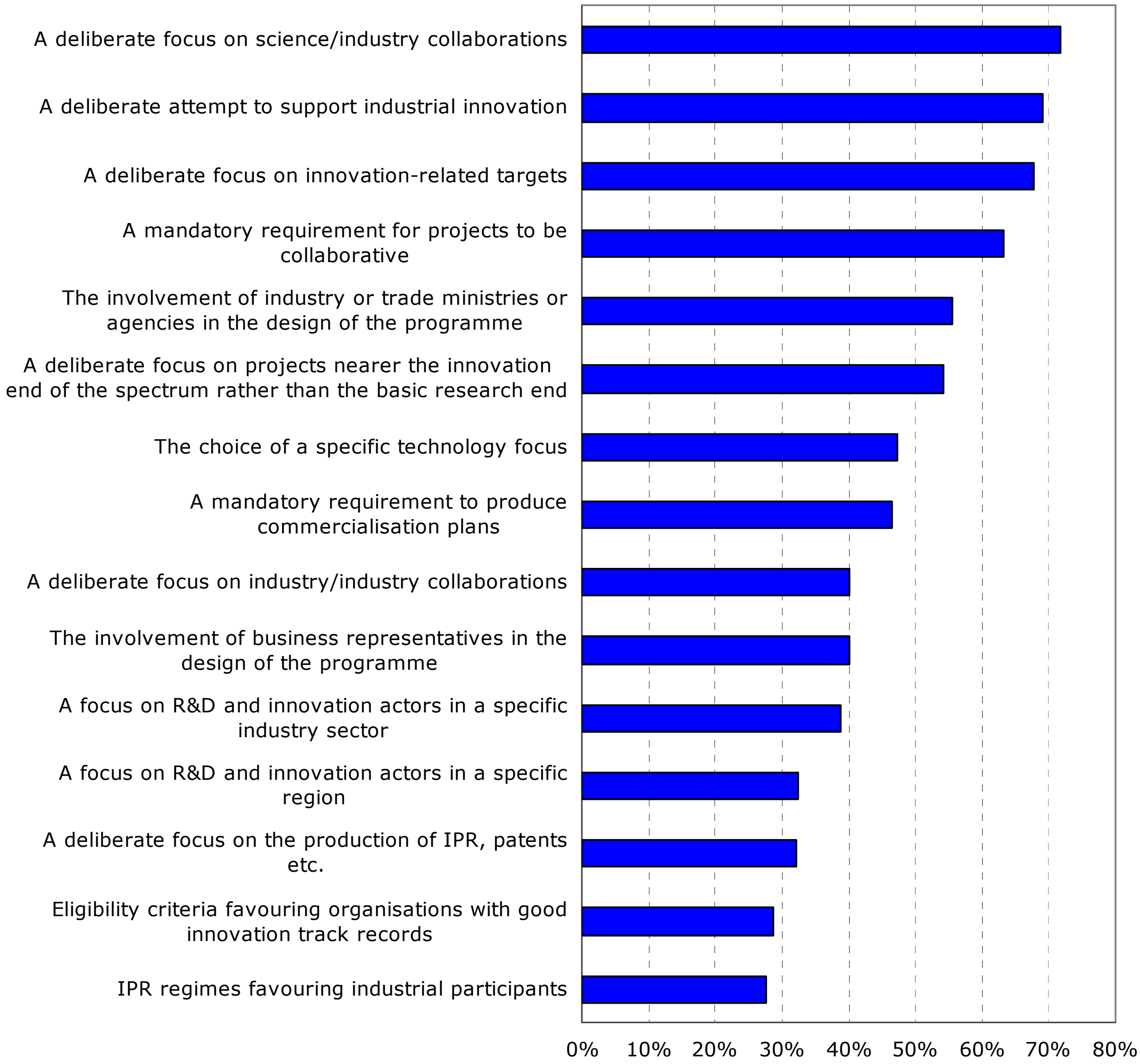
Figure 14: The innovation impact of R&D programmes' history and genesis as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

The general design of an R&D programme is likely to have an impact on innovation. The results of the survey of programme managers suggest that innovation should be anchored as early as in the design of the programme. However, even more important seems to be the collaboration between science and industry in the framework of R&D programmes. In general, it is perceived that collaboration has a positive effect on innovation impacts. This result is interesting since the analysis of the R&D programme landscape in Europe has shown that most of the programmes in the established innovation systems support collaboration. In about half of the R&D programmes in the catching-up countries collaboration is mandatory. The same is true for about 38% of the programmes in the New Member States. The majority of programme managers answered that science/industry collaboration has a positive effect on innovation impact. This matches the existing programme structure quite well, since the major form of collaboration in R&D programmes in Europe is between parties from scientific institutions and private firms. Interestingly, IPR regimes are not considered very important for innovation impacts. This result is consistent with the InnoImpact study that derived the conclusion that the surveyed organizations were not very keen on keeping knowledge private with traditional intellectual property protection mechanisms such as patents. This suggests that R&D programmes are particularly valuable with regard to the establishment of contacts between science and industry, possibly leading to the transfer of tacit knowledge. More formal ways of transfer, such as IPR, are not considered to be very important.

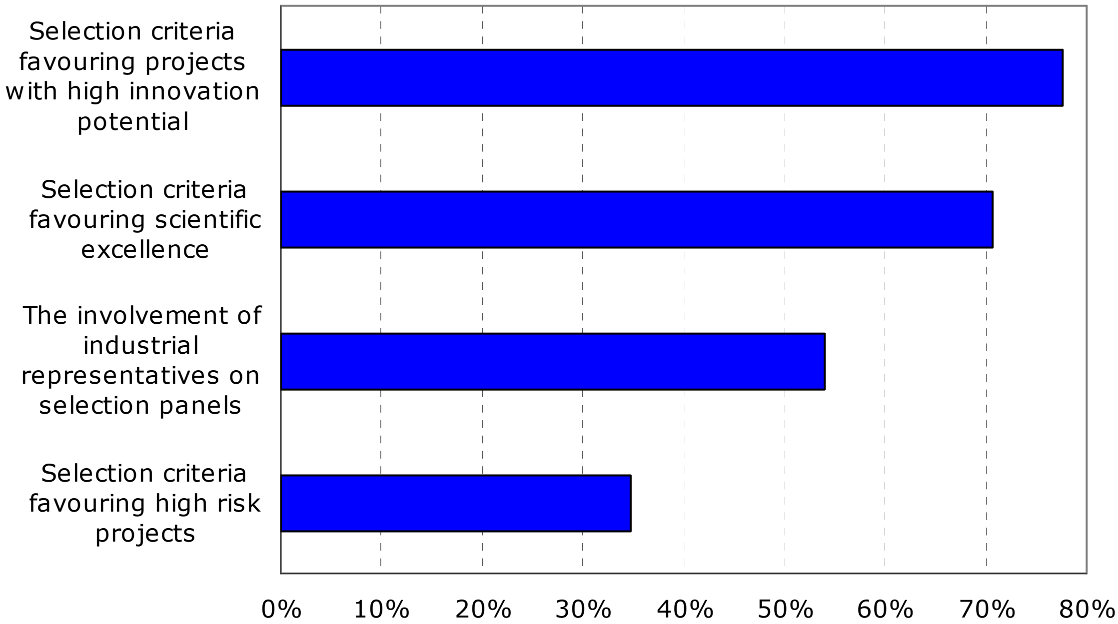
Figure 15: The innovation impact of general design features of R&D programmes as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

This figure suggests that the selection criteria that favour projects with high innovation potential are also likely to lead to high innovation impacts. However, selection criteria that favour scientific excellence are also considered highly important in order to achieve innovation impacts. Selection criteria favouring high risk projects as well as the involvement of industrial representatives on selection panels are considered less important for innovation impacts. This result suggests that high scientific excellence and high innovation potential need not be in conflict.

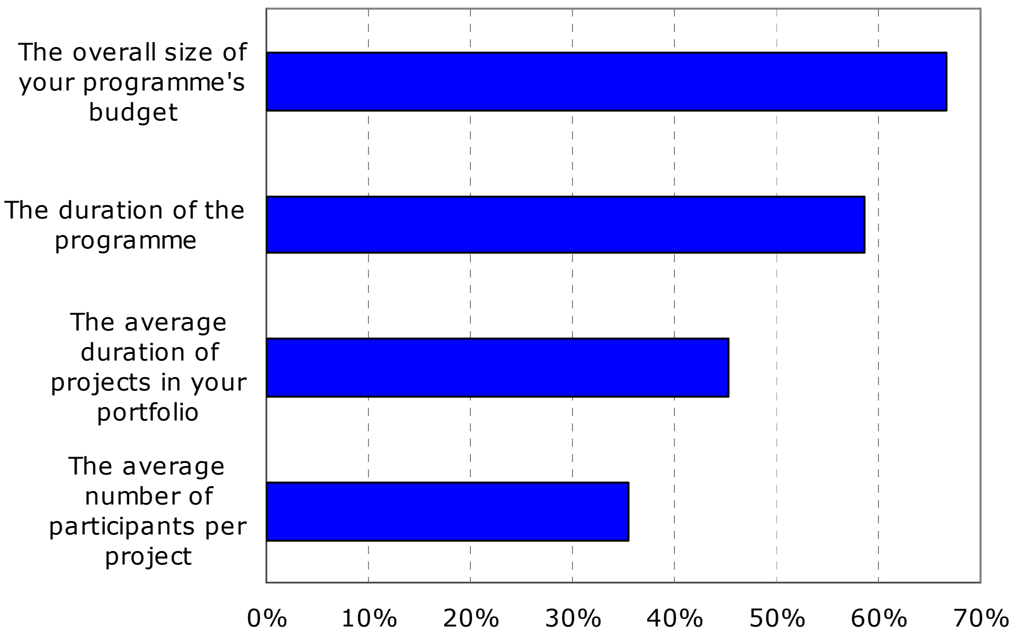
Figure 16: The innovation impact of selection criteria of R&D programmes as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

As may be expected, the overall size and the duration of the programme are perceived to have a high impact on innovation, as indicated below. About one third of the programme managers are of the opinion that the average number of participants per project has a high or very high impact on innovation.

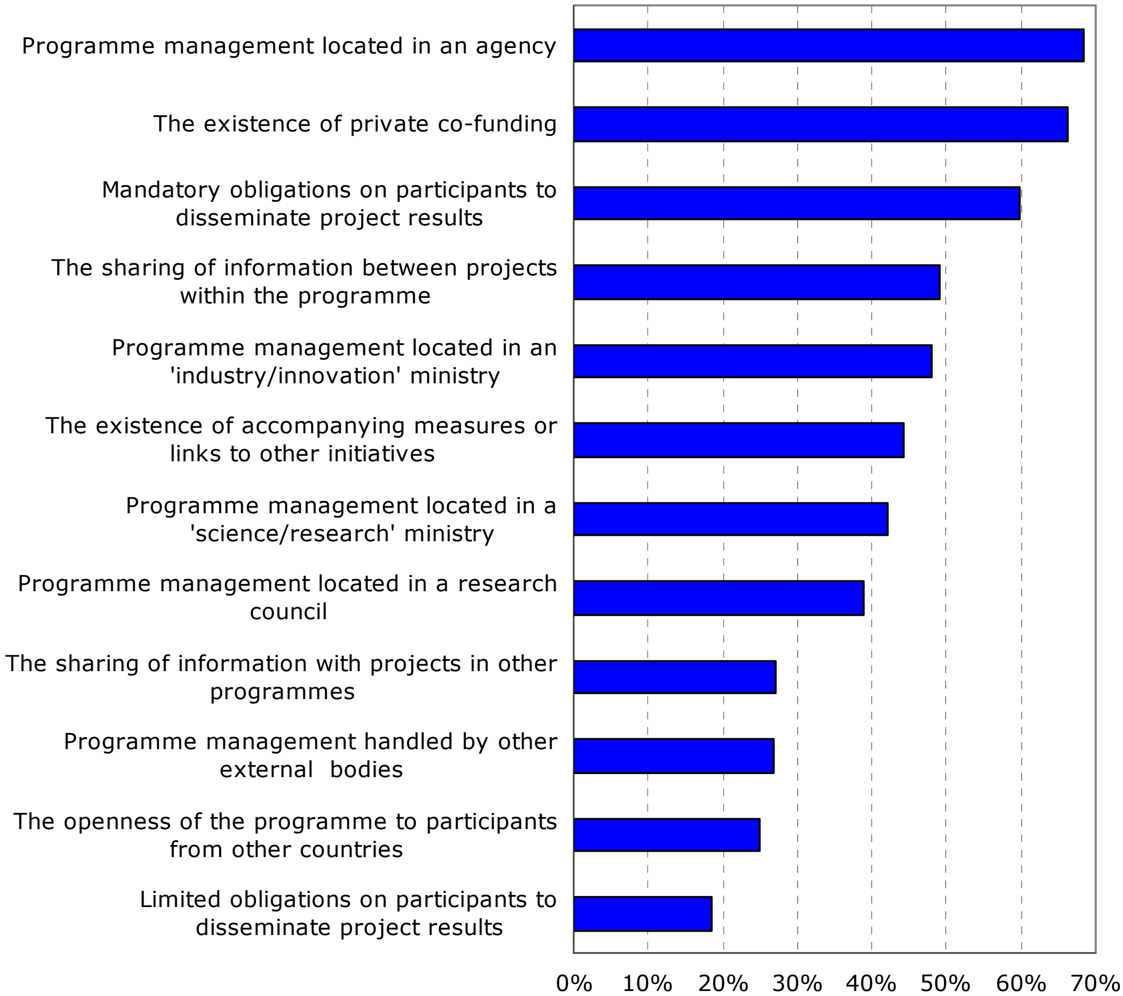
Figure 17: The innovation impact of different characteristics of R&D programmes as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

The impact of programme management on innovation is shown by the figure below. The majority of programme managers think that a high innovation impact is achieved if the programme is managed by an agency. This result has to be interpreted with caution since a large share of the respondents of the survey work for an agency themselves. The results from the programme database show that the majority of R&D programmes in the established innovation systems (54%) and the catching-up countries (52%) are managed by managing agencies. In the New Member States this is true for 45% of the R&D programmes. The existence of private co-funding is highly relevant for innovation impact. This result is intuitive, since industrial partners who put their own money into the project are likely to strive for commercial exploitation. R&D programmes that include mandatory dissemination of the project results to the public are also perceived as having a high innovation impact. In this context it is important to point to the possible conflict between the early dissemination of the project results and the fact that the private industry may stand to gain from keeping results secret in order to have a competitive advantage. Thus, the type of information that is disseminated is relevant in this context.

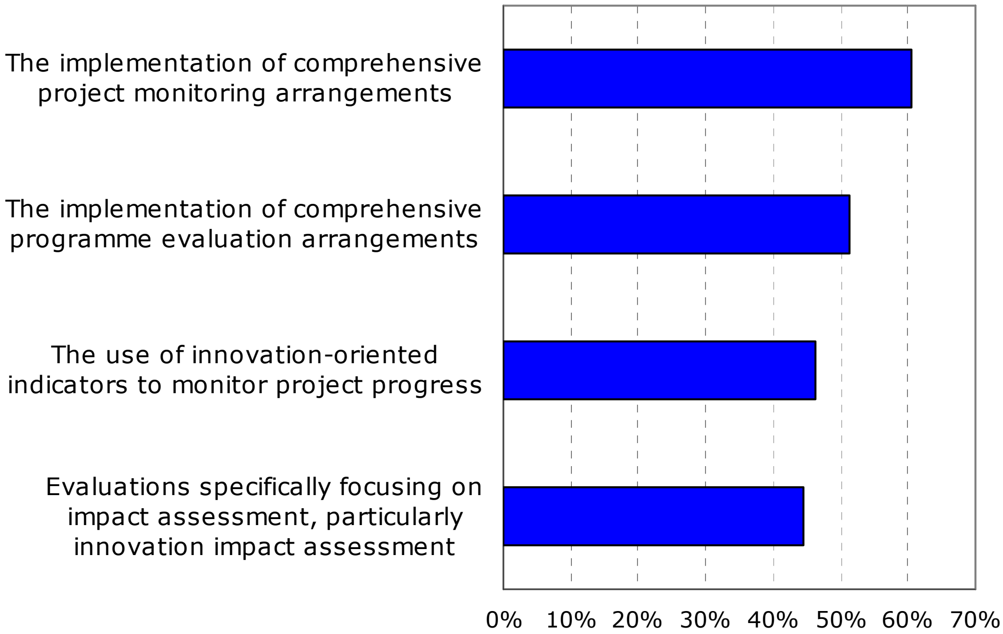
Figure 18: The innovation impact of R&D programmes' management characteristics as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

The next figure reveals the link between monitoring and innovation impact. It shows that even though about 60% of the respondents are convinced that the implementation of comprehensive project monitoring arrangements is important to achieve innovation impact, only 44% actually agree that innovation impact assessment is important to achieve high or very high innovation impact. This hints at the fact that R&D programmes usually serve a number of different, partly conflicting, objectives and goals and that innovation impact cannot be regarded as the most important objective in most cases.

Figure 19: The innovation impact of R&D programmes' monitoring characteristics as perceived by programme managers



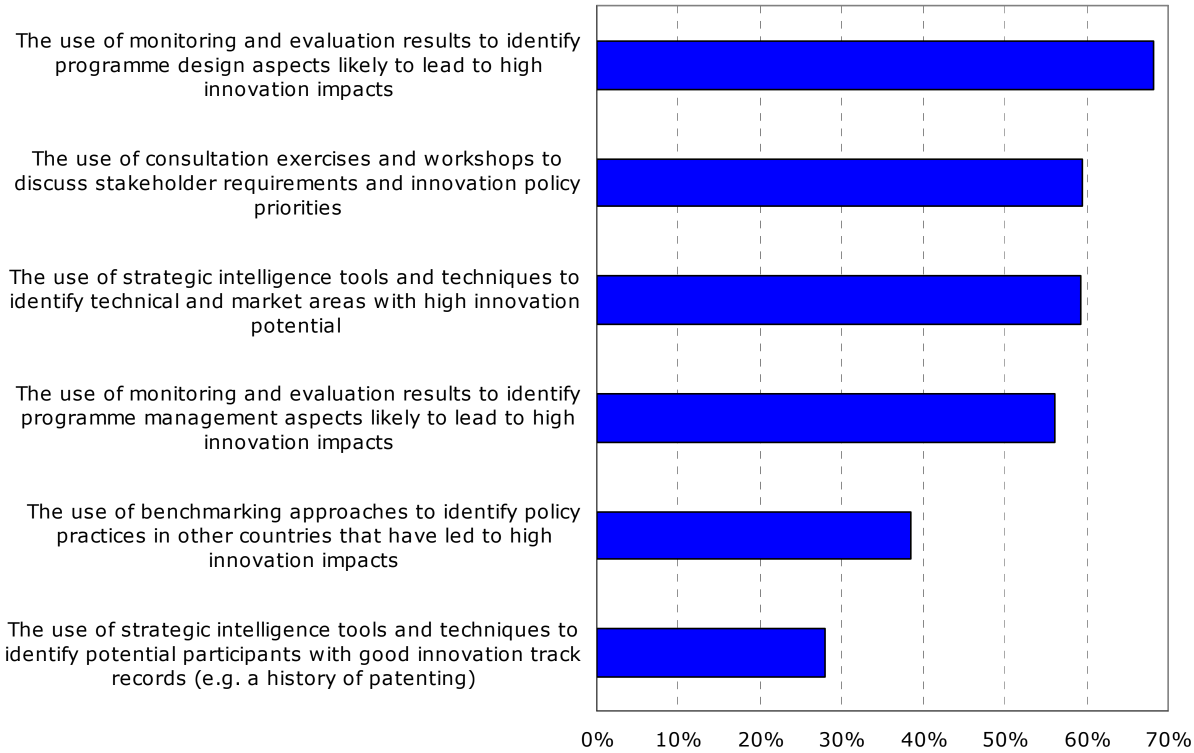
Share of respondent answering high or very high
Source: Survey of R&D programme managers.

4.2.3 Strategies to Improve the Impact on Innovation

Programme managers of R&D programmes in Europe were asked about their strategies to improve impact. The results presented here indicate that monitoring and evaluation results are frequently used to identify programme design aspects likely to lead to high innovation impacts. Workshops and consultation exercises are often used to discuss stakeholder requirements and innovation policy priorities. More than one third of the respondents use benchmarking approaches to identify policy practices in other countries.

Interestingly, the survey responses reveal that a considerable share of programme managers uses international benchmarking as a strategy to improve innovation impact in domestic programmes. This result confirms the results from the focus groups, where rather similar programmes were identified as best practice examples. This is particularly true for the R&D programmes that aim at increasing science/industry collaboration. A number of countries installed programmes that fund research collaboration between scientific and industrial parties. The design, management and evaluation characteristics of those programmes are quite similar. The evaluation of the Swedish competence centre programme which supports science/industry collaboration hints explicitly at the fact that the programme and its characteristics have been copied in a number of countries, for instance, Austria (Vinnova 2004).

Figure 20: Useful strategies to improve the innovation impact of R&D programmes as perceived by programme managers



Share of respondent answering high or very high
Source: Survey of R&D programme managers.

Another major instrument of international collaboration with regard to benchmarking is the TAFTIE network. TAFTIE (The Association for Technology Implementation in Europe) is a group of 19 organisations from 19 countries that collaborate in the field of implementation of technology programmes. The purpose of TAFTIE is to learn best practices from an analysis of the programmes in other countries. Thus, it becomes clear that there are clear mechanisms of international benchmarking and learning established in order to increase impact.

4.2.4 Conclusions

The survey of programme managers has shown that a number of programme characteristics are assumed to have a particularly important impact on innovation:

- As might be expected, R&D programmes that have a strong innovation-related rationale are perceived as having a high innovation impact.

- Collaboration is highly relevant for innovation impact. This is particularly true for science/industry collaboration, which the programme managers perceive as having a strong positive impact on innovation. A focus on intellectual property rights does not have a strong impact on innovation.
- The survey results show that R&D programmes that favour projects with high innovation potential as well as scientific excellence are regarded as having a high innovation impact. Thus, a focus on innovation and scientific excellence is not contradictory.
- As one might expect, the programme managers that responded think that the overall size of the programme's budget and its duration are highly relevant for innovation impact.
- The majority of programme managers think that a high innovation impact is achieved if the programme is managed by an agency. This result has to be treated with caution since a large share of the respondents of the survey work for an agency themselves. The existence of private co-funding is highly relevant for innovation impact. This result is intuitive, since industrial partners that put their own money into the project are likely to strive for commercial exploitation. Mandatory dissemination of project results is also regarded as having a positive effect on innovation.
- Monitoring and evaluation mechanisms also have a positive impact on innovation in the opinion of the programme managers.

R&D Programme managers can apply different strategies to increase innovation impact:

- Monitoring and evaluation results are frequently used to identify programme design aspects that lead to high innovation impacts.
- Stakeholders are often involved in consultation exercises and workshops in order to improve innovation impacts.
- International benchmarking and learning from other countries are quite often applied to increase the impact of R&D programmes. The New Member States frequently copy R&D programmes from other member states. Design features of certain types of R&D programmes, such as programmes supporting science/industry collaboration, are frequently copied in other countries.
- There are well-established networks of programme management agencies that facilitate benchmarking and international learning in Europe.

4.3 Impact on Innovation: Lessons from Evaluations

This chapter identifies good practice examples for measuring innovation impacts and learning from evaluations to improve a programme's contribution to innovation. The analysis of current evaluation practice in the EU shows that:

- The purpose of evaluations in most of the countries is to assess impacts and effectiveness of R&D programmes. Furthermore, evaluations are used to improve programme management.
- The most frequently used evaluation methods are ex-post and interim evaluations. The analysis of the programme database has shown that about 90% of the programmes are evaluated. The analysis of evaluation reports shows a totally different picture. Evaluation is often equated with monitoring, reports are mostly published in the national language and appraisal reports are often relegated as grey literature. Thus, the number of actually accessible evaluation studies is unknown.
- There is a clear need to create monitoring structures in order to facilitate quantitative measurements.
- The quality of evaluation studies has increased within the last years, however, only few evaluations can be used as good examples with regard to impact assessment.
- Few evaluation studies have measured the effects on the wider economy and society. Impact assessment is regularly undertaken in the USA, U.K., Norway, Sweden, and Finland. Germany, France and New Zealand hardly ever use these more quantitative evaluation methods to assess the effectiveness of technology and research policy instruments. In the New Member States evaluation studies are considered to be success stories since a large number of the existing R&D programmes have been drawn up recently.
- The methodologies used in the evaluation reports were identified and a more detailed account is given for Austria, Finland, Germany, Hungary, UK and US in order to identify good practice examples.

This section focuses on ways how the evaluation of R&D programmes can contribute to improving the programmes' innovation impacts. Evaluation results can provide important information on how well programmes have worked and which programme features proved to be particularly helpful to generate innovation impacts. Evaluation results are thus a means of learning which are - according to the survey of R&D programmes - already widely used today (see Figure 20 in the previous section). However, there are only a minority of R&D programmes that apply evaluation approaches that are specifically designed to uncover the innovation impacts of these programmes (see Figure 19). One-main purpose of this section is thus to review current evaluation practice in the area of R&D programmes and to analyse how existing evaluations can be better utilised and improved for a better information flow to the R&D programme managers to (re-)design their programmes for a higher innovation impact.

While analysing evaluations in view of these issues, several dimensions should to be considered:

- First, different types of evaluations (ex-ante, midterm, ex-post, ongoing, impact vs. efficiency evaluations) provide different types of information about different stages of a programme's development.
- Secondly, different methods of impact assessment will naturally provide different types of conclusions on programme impacts.
- Thirdly, good practice in evaluations methods is highly context specific since evaluations need to adapt their approaches to the programme characteristics (objectives, target groups, targeted activities, type of funding etc.) and the programme environment (for example, other policy initiatives in place, R&D system characteristics, innovation challenges).

The results presented in this section are based on three sources of information: A literature survey, results from the R&D programme manager survey presented in the previous section, and a comprehensive survey of impact evaluations of R&D programmes in Europe and the USA. First, we present the different current evaluation practices in R&D policy, discussing issues of evaluation purposes and objectives, types and methods used, and how programme impacts can be captured. Secondly, we discuss the results of a detailed analysis of 46 recent evaluations studies on R&D programmes from Europe and the USA.

4.3.1 Evaluation Practice

Almost all public R&D programmes and initiatives run today in the EU member states are subject to some type of monitoring or evaluations that aim at identifying and assessing how well a programme works, to what extent the programme objectives are met and how the design and management of programmes can be improved. The methods applied for this purpose are manifold, including quantitative and qualitative approaches (Luukkonen 1998). Evaluation practices vary considerably across countries, reflecting both differences in the type of policy instruments and approaches applied, and the history of policy making and policy review. At the same time, the science of evaluation has made significant steps towards more elaborated methodologies and a common set of techniques (Calidoni-Lundberg 2006).

Main types of evaluation

An evaluation can take place at three possible times during the development and implementation of a programme: before a programme is launched (ex-ante assessment), whilst it is in progress (interim or ongoing evaluation, including programme monitoring) or after the programme has ended (ex-post). These three types of evaluations differ in many respects, for example, in scale, in scope, in the methods used, in the extent to which results are disseminated, in terms of the users of evaluation results, and in terms of the purpose for which evaluation results are used:

- **Ex-ante evaluations** typically focus on the relevance of programme objectives and intervention approaches, the link between identified challenges and planned programme activities, the effects to be expected from programme implementation, the relation of the programme to other policy activities, the management structure foreseen to run the programme and how this fits to the planned programme activities, the strategies to identify and approach the target group of the programme, the procedures foreseen to apply for funding and to select projects, including the adequacy of eligibility criteria, and the adequacy of the volume of the programme (in financial terms). Ex-ante evaluations are mostly conducted as part of the preparation process of a new programme and are often done by the staff of the agency responsible for the planned programme. Documents produced for such types of ex-ante evaluations are rarely made public. External ex-ante evaluations are more common for very large programmes and often have a specific focus, for example, for identifying adequate indicators for monitoring the programme, or assessing the planned approach of certain target groups of a programme.

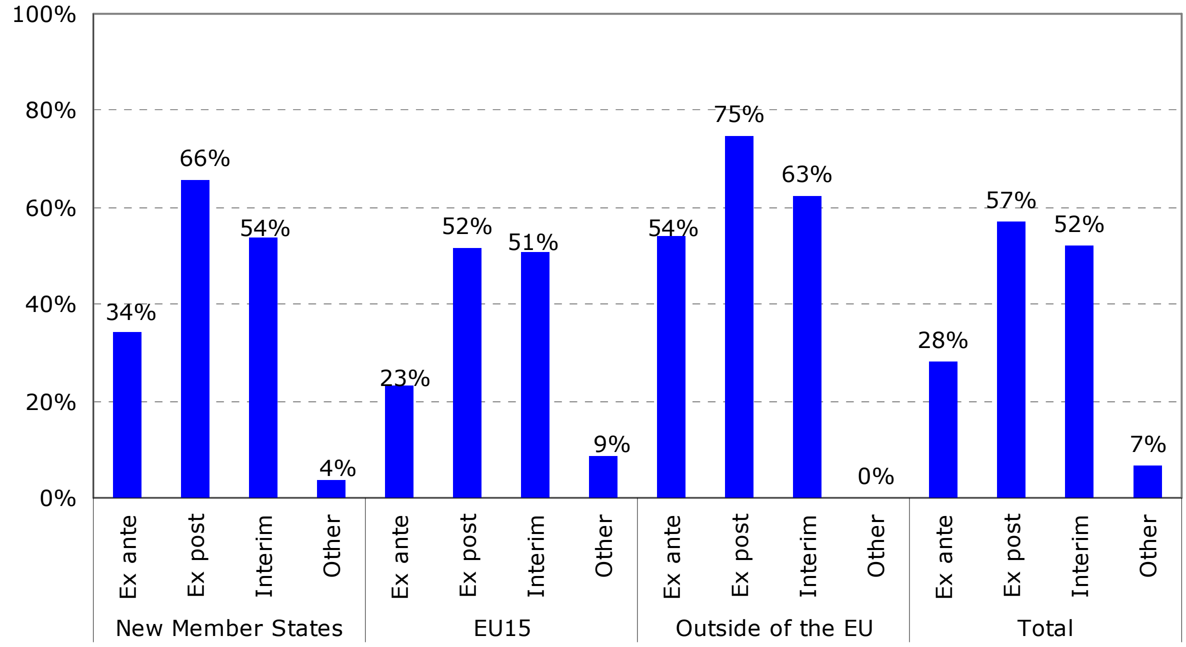
- **Interim evaluations**, including reviews and monitoring activities during a programme's term, are basically intended to asses the progress of a programme. This type of evaluation is typically applied to longer term programmes. Their purpose is first of all to inform programme managers and policy makers about likely adaptations needed in the design and management of the programme in order to achieve a higher programme output or to respond to changes in the challenges a programme wants to tackle, as well as to changes in the programme's environment (for example, changes in activities of other programmes). Many interim evaluations are part of ongoing monitoring activities of the programme management and are either conducted by the programme managers themselves or by external experts. Interim evaluations tend to be published in the context of progress reports and are often of descriptive nature, focusing on some key indicators such as number of beneficiaries and volume of funding broken down by some characteristics of beneficiaries or funded projects.

- **Ex-post evaluations** primarily examine the results of a programme after it has been completed. Ex-post evaluations particularly focus on impact assessment (i.e. the effectiveness of a programme) and cost-benefit analysis (i.e. the efficiency of using programme funds). Such types of analyses can be carried out only after a programme is completed. With respect to impact assessment, often a certain time lag between the end of a programme and certain impacts that are observed has to be considered. A large time lag will, however, limit the potential for learning from an evaluation for a re-design of programmes or setting up new policy initiatives since policy rationales will demand some sort of continuation of policy activities. For some programmes, ex-post evaluations therefore already start while the programme is still running in order to produce conclusions and recommendations on whether and how to continue the programme directly after the programme ends. Such a strategy certainly limits the scope of analysis in terms of impact assessment. Ex-post evaluations are predominantly carried out by external experts, and most ex-post evaluations are published.

Managers of public R&D programmes indicated that more than 90% of all programmes are subject to some sort of evaluations. The most frequently used evaluation method -according to our survey of R&D programme managers- are ex-post evaluations, followed by interim evaluations (see Figure 21). Ex-ante evaluations are less frequent in the EU-

15 while about every second R&D programme in the third countries that was covered by the R&D programme manager survey underwent an evaluation before the programme was started. The R&D programme manager survey also shows that most programmes in the EU15 tend to be subject to only one evaluation -either ongoing or ex-ante- while in third countries and, to a lesser extent, in the New Member States, more programmes are evaluated at more than one stage.

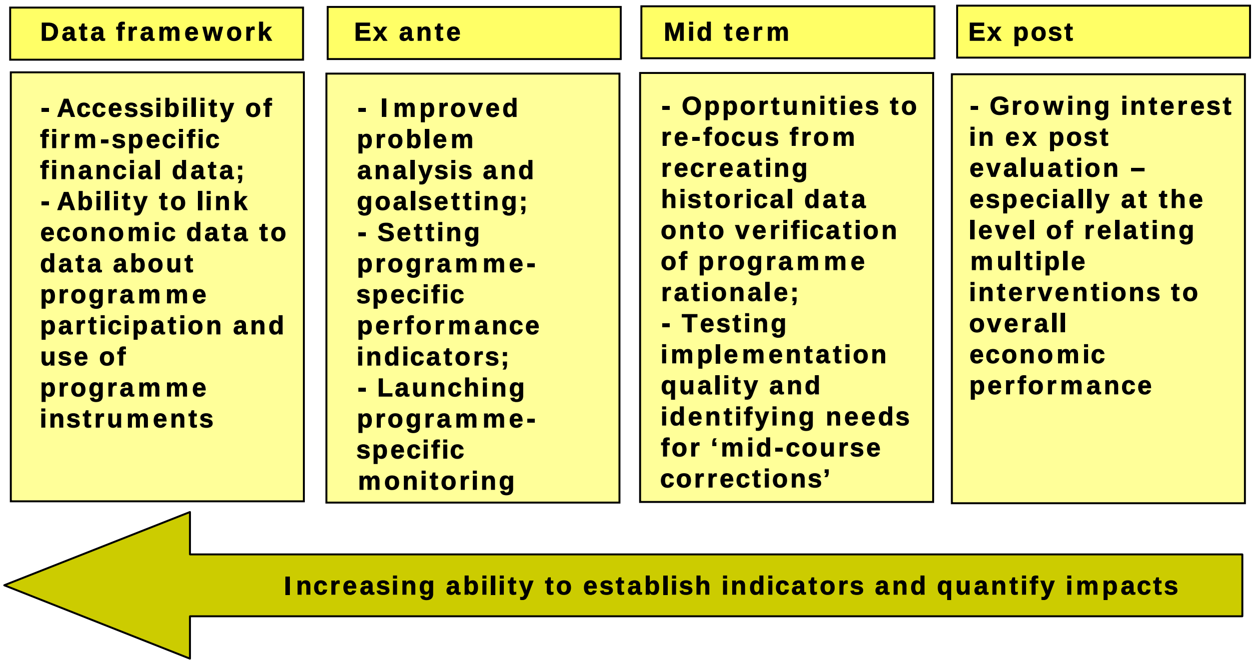
Figure 21: Applied type of evaluation in R&D programmes



Source: Survey of R&D Programme Managers.

In order to inform programme managers and policy makers about programme outputs and effectiveness before the programme is completed, programmes could set up a data framework which privides information on evaluations at the various stages of a programme's development. Through such a data framework, ex-ante, mid-term and ex-post evaluations as well as a continuous programme and project monitoring can be interlinked and feed each other. Figure 22 provides an example for linking the timing of evaluation activities and a data framework of a programme.

Figure 22: Timing of evaluation activities



Source: based on Boekholt (2001, p. 77).

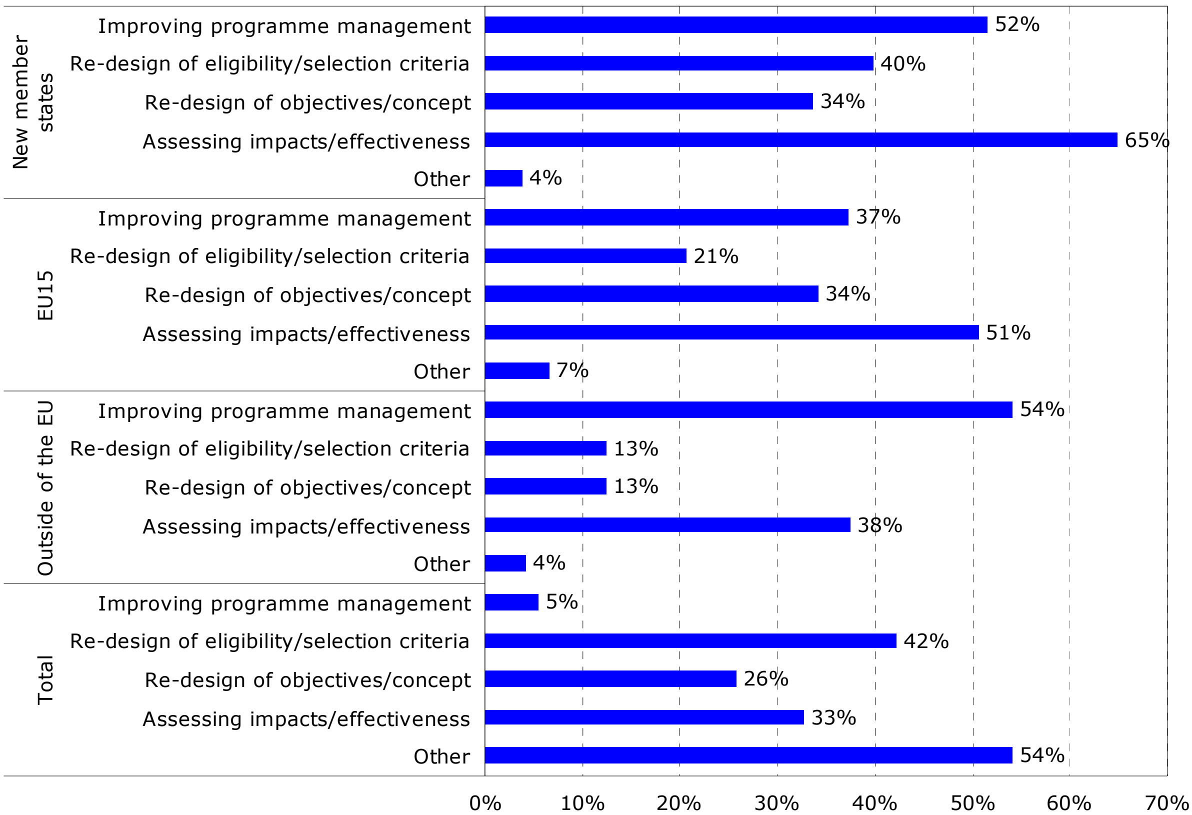
Purpose of Evaluations

Programme evaluation typically serves several purposes, some of which directly relate to programme activities while others focus on the role of programmes and initiatives in a wider policy context. Typically, R&D programme evaluations could

- Inform policy makers and programme managers about the coherence between programme activities and programme objectives (for example, with respect to target groups and targeted activities funded under a programme);
- Assess the relevance of a programme's rationale and intervention approach, particularly under a dynamic and rapidly changing environment;
- Analyse whether programme resources were used efficiently, i.e. generating a maximum amount of desired activities with a certain amount of funds;
- Identify intended and unintended impacts of programme activities both on the side of beneficiaries and third parties;
- Help policy makers and programme managers to identify areas for re-designing programmes and the wider policies initiatives under which a programme operates;
- Help policy makers and programme managers to better understand the interaction between programmes and policies on the one hand and R&D and innovation processes on the other;
- Identify upcoming challenges and barriers that should be addressed by new or adapted policy approaches.

R&D programme managers report that assessing the impact of programmes (i.e. their effectiveness in terms of achieving programme objectives) is the most important purpose of evaluations (Figure 23). Anther important purpose is to improve programme management, i.e. assessing the efficiency of a programme and identifying areas for improving the way a programme is implemented. While programme managers from EU member states rank impact assessment highest, programme managers from third countries say that improving programme management is the prevalent purpose of evaluations. Less common are evaluations that focus on how programmes could be re-designed in terms of fixing programme objectives, defining target groups and eligibility criteria.

Figure 23: Purpose of R&D programme evaluations

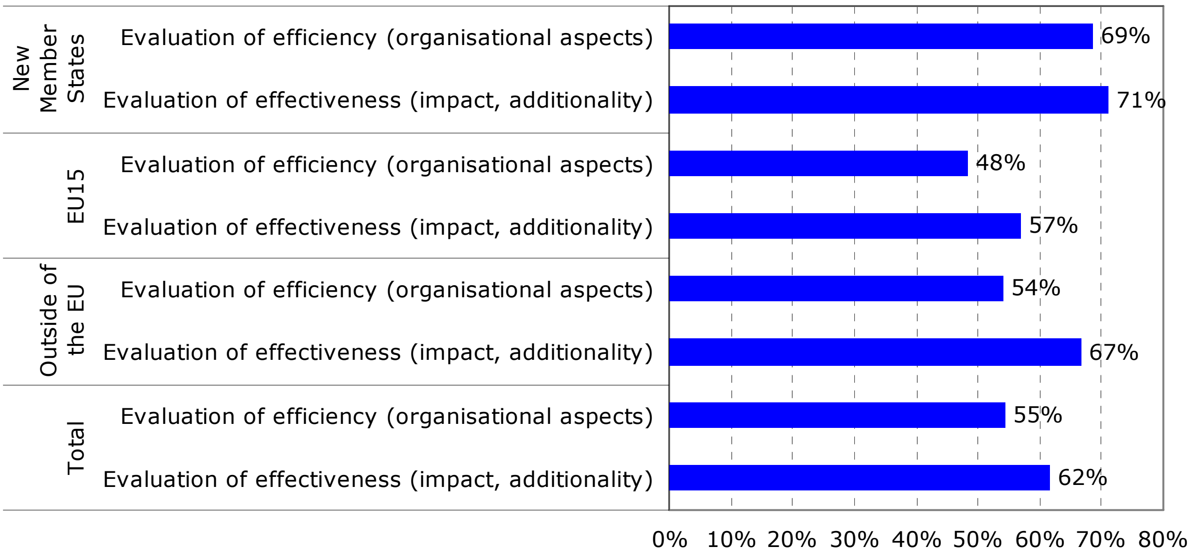


Share of programme managers stating that the respective purpose of evaluation had a high or very high importance for the evaluation of programmes they are responsible for.
Source: Survey of R&D programme managers.

With respect to evaluating the results of a programme, one traditionally distinguishes efficiency from effectiveness evaluations (see Polt 1998). According to the response of R&D programme managers, efficiency evaluations are somewhat more common than measuring effectiveness (Figure 24). Efficiency evaluations typically examine how well a programme was administered, how high compliance costs of beneficiaries were, how well the programme objectives and priorities were communicated to the target group, how programme progress was measured and transferred into a learning process, how capable the programme management was to detect and address emerging problems, etc. Another key issue of efficiency evaluation is to relate the spending of programme funds to indicators such as the number of projects funded and the number and quality of publications, patents or new products generated by these projects.

Evaluations that examine the effectiveness of a programme investigate to what extent a programme was able to meet its objectives. For this purpose, indicators that measure the programme objectives are needed. Depending on the programme, objectives can either relate to outputs (for example, number of projects, private investment complementing public money, number of people involved in R&D projects), outcomes of funded R&D projects (for example, publications, patents, new products changes, changes in the behaviour of participants such as establishing of sustainable networks) and impacts both on the side of beneficiaries (for example, changes in economic performance, increase in the number of employees) or on the side of third parties (for example, level of productivity in a sector, socio-economic impacts). The demand for impact assessment of public R&D programmes can be seen as one element on the move toward a knowledge-based society since such evaluations can increase our understanding about the links between knowledge production (R&D), knowledge exploitation (innovation) and wealth (productivity, employment). Policymakers thus want to know what the results of their past policies have been in order to have a better idea of what the results of future policies are likely to be.

Figure 24: Type of ex-ante evaluation of R&D programmes



Share of programme managers stating that the respective type of ex-ante evaluation had a high or very high importance for the evaluation of programmes they are responsible for.
Source: Survey of R&D Programme Managers.

Types of impacts

Evaluations that attempt to measure programme impacts will have to consider different dimensions of impacts. Table 24 illustrates some of the most important dimensions: the main domain of impact (for example, the actors who experience the impact), whether impacts are intended (i.e. part of programme objectives) or unintended (i.e. not directly mentioned in the programme) and whether impacts occur within a short time lag to programme activities (short-term impacts) or in later time periods (long-term impacts). A further dimension refers to whether impacts are on the beneficiaries of a programme or on third parties (direct versus indirect impacts). Assessing programme impacts is rather easy -in terms of data requirements and methods needed- for intended short-term impacts that remain within the beneficiaries of a programme. Such impacts can typically be measured by surveying participants either through questionnaire approaches or through relying on publicly available data such as publication data bases or patent data bases. Impact assessment becomes much more difficult where long-term impacts, indirect impacts and unintended impacts are concerned.

Table 24: Typical impacts of public R&D programmes by impact dimensions

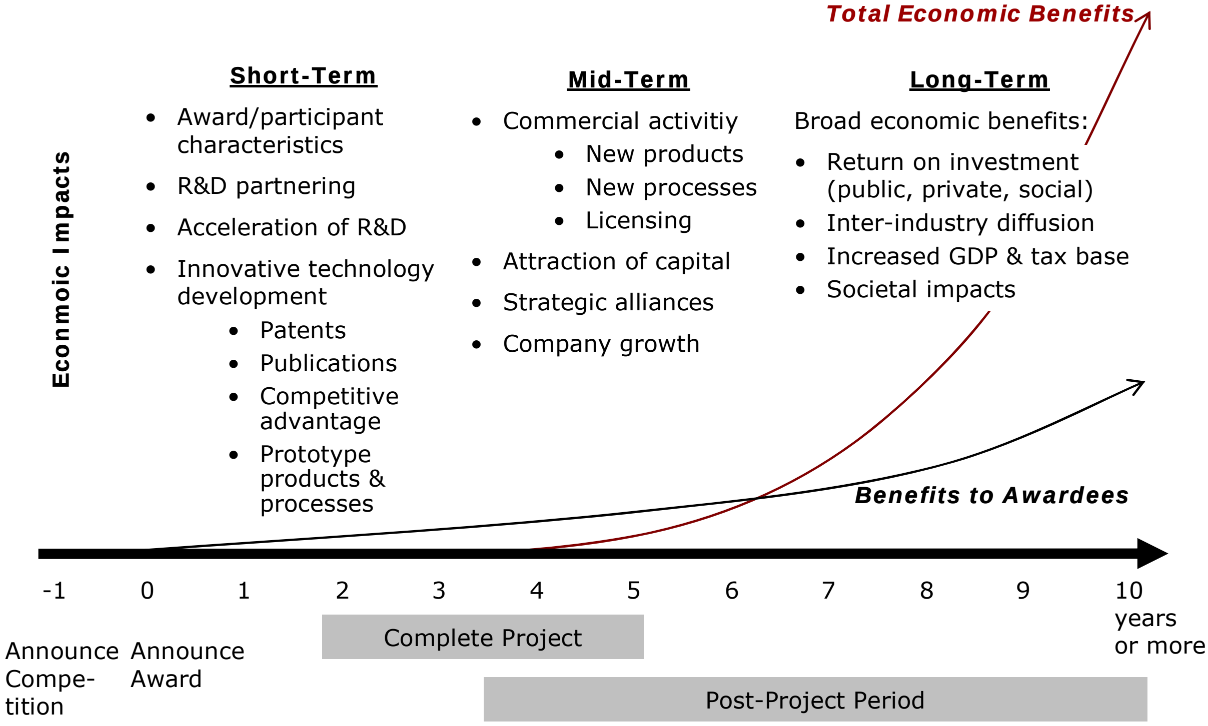
Main domain		*Intended impacts*		*Unintended impacts*	
		Short-term	*Long-term*	*Short-term*	*Long-term*
Public science	Direct Indirect	scientific findings	spur scientific knowledge production	improved teaching	industrial spill-overs
Enterprises	Direct Indirect	new products, improved technology	developing new fields of technology	increased productivity	improved competitiveness
Policy	Direct Indirect	improved understanding	improved identifying and solving of problems	increased problem awareness	increased general satisfaction

Source: based on Georghiou (2002, p. 150).

With respect to innovation impacts, which are often long-term, indirect and not necessarily intended by the programme's key objectives. While R&D projects tend to last two to three years (see the results of the InnoImpact study), turning R&D results into successful innovation is likely to demand a similar time span (see Leitner 2003 for case studies on the length of successful innovations), while economic benefits from innovation and indirect effects on other actors may require even more time. The longer the time lag between programme activity and likely programme impacts, the more difficult it is to observe these impacts and to relate them to the programme. Capturing indirect effects is complicated by the potentially very large number of actors outside the programme that may be subject to (positive or negative) indirect impacts. Unintended impacts can, for example, correspond to learning processes by programme participants as well as by third parties and these may raise their innovative capacities which are difficult to observe.

To exemplify the link between impact measurement and the time horizon of impacts, Figure 25 shows a timeline of effects originating from projects of the U.S. Advanced Technology Program (ATP). From the short-term indicators, those are identified that are considered for long-term benefits. Using an appropriate data collecting system, information about programme participants is aggregated and assessed afterwards. In the long run not only project impacts are measured, but also the broad-based economic benefits such as productivity, employment and technology diffusion across industries.

Figure 25: Timeline - what can be measured when



Source: based on Ruegg (2003, p. 65).

Methods and limitations of impact assessment

Evaluation research has developed a variety of methods to evaluate public programmes and identify the effects that these programmes have generated. Appendix 2 of this report summarises methodologies used to evaluate and benchmark R&D programmes. Table 25 provides a very brief summary of the strengths and limitations of the methodologies often used to evaluate R&D programmes. The six most widely used evaluation methods are interviews/peer reviews, case studies, analysis of monitoring data, survey of participants, control-group approaches (i.e. a survey including non-participants) and econometric modelling (either on a micro level based on participant data or on a meso/macro level analysing the contribution of public R&D programmes on certain sectors or the economy as a whole). While each method can contribute in some way to assessing a programme's innovation impact, there is no best method since each suffers from several limitations. While interviews and case studies can provide important insight into how R&D results may be transferred into innovations, and potentially trigger innovation activities of non-participants, these findings are difficult to generalise and may be subject to an overestimation of positive impacts. Monitoring data and a survey of beneficiaries are methods suitable to derive representative results, however they are strongly bounded to short-term and direct effects and thus have a limited scope to capture innovation results. Control group approaches and econometric modelling are certainly better ways to identify impacts, but demand high data quality which is costly and time consuming to fulfil. Particularly, a large number of variables that are likely to affect innovation performance of participants and non-participants need to be considered. Many of these variables tend to vary by sector or field of technology which further complicates data collection in case of programmes targeting various thematic areas.

Table 25: Overview of main methodologies to evaluate R&D programmes

Methodology	*Strengths*	*Limitations*
Interviews, peer reviews	Evaluation of scientific merits, flexible, wide scope of application	Peer dependence, subjectivity, impacts hardly to capture
Case studies	Illustration of how a programme works, understanding how context affects and shapes impacts	Results cannot be generalised, partly subject to self-assessment of participants
Analysis of monitoring data	Simple and cheap to carry out	Confined to inputs and short-term outputs of funded activities, no impacts and no indirect effects covered
Survey of beneficiaries	Quick way to obtaining data about programme effectiveness (results achieved through funded activities) and efficiency (e.g. user satisfaction, compliance costs), allows to differentiate results by characteristics of beneficiaries	High costs, time consuming, depends on respondents' willingness to participate, biased results in case of unbalanced or low response rate
Control group approach	Captures the impact of policy intervention on programme participants while controlling for potential selection biases	Requires information both on participants and non-participants which is difficult and costly to obtain
Econometric modelling	Empirical analysis of causal relationships between dependent and independent variables, produces quantitative results	Very high data requirements which can rarely be satisfied, models typically incomplete

Source: Polt and Rojo (2002), analysis of evaluation studies.

The various challenges that impact assessment of R&D programmes are facing can be summarised as follows (Boekholt et al. 2001, Feller and Ruegg 2003, Fahrenkrog et al. 2002):

- *Attribution of impacts*
  One of the major challenges of the appraisal of impacts is the difficulty in defining what type of effect to measure and attributing them to a specific policy measure. Since economic objectives are normally pursued by publicly-funded support for business R&D – for example, contribution to economic growth and enhanced productivity – social goals such as improved sustainability, health or employment come second on the agenda. The impact of these government interventions is scrutinised by questioning whether deliverables or innovations resulted from the funded project.

- *Project fallacy*
  When evaluating R&D programmes, the results achieved from a publicly-funded project are analysed in order to assess the impacts of this policy action. As enterprises are engaged in a variety of projects, research impacts are often cumulative. Therefore, the evaluation should not focus on the results gained but more on the contribution that the government support makes to the company's broader objectives. On a wider view a programme fallacy can also be identified easily since R&D programmes are only one instrument amongst others with an impact on innovation. Programmes should be designed with a view to complement other programmes and build synergies with respect to innovation impact.

- *Multiple objectives*
  R&D programmes are often characterised by multiple objectives because pro-

grammes span a considerable range of activities from basic research to close-to-market research. Impact assessments often experience several challenges which can be handled by focusing on key impacts and examining certain indicators in-depth in a limited sample of cases.

- *Time lag*
  The time lag of effects differs from programme to programme. To identify innovation impacts is quite difficult as most of the programmes run over a period of five to ten years. Innovation impacts typically take some time to become observable. In many fields of science and technology, several years may past until one can determine whether a R&D activity funded under a programme has generated successful innovation, especially when strategic/basic research is involved. On-going programmes can hardly be appraised with respect to innovation impacts.

4.3.2 Analysis of Evaluation Studies

A main purpose of this section is to identify good practice in impact assessment of R&D programmes through programme evaluation. For this purpose, a thorough review of evaluation reports of ongoing or recently ended R&D programmes in the EU and some third countries has been performed. First, the network of country correspondents was used to identify relevant evaluation reports. Secondly, these reports were collected and analysed with respect to the aims of the evaluations, the methods used and the experiences made with respect to identifying programme impacts. Thirdly, candidates for good practice examples were selected and examined in more detail using additional information, including responses from country experts.

Identifying good practice in impact assessment through evaluation turned out to be rather challenging. While the survey of R&D programme managers revealed that most R&D programmes are assessed or evaluated in some way, assessing these evaluation reports is difficult, partly because they are not officially published but only available for internal purposes. Furthermore, many evaluations primarily or solely focus on programme monitoring results and are very descriptive in nature, thus containing no evidence on practices to assess programme impacts. The variety of evaluation approaches used in different countries, and the strong dependence of evaluation methodologies on specific programme designs and policy making traditions, further complicate cross country comparison.

A total of 46 evaluation reports were compiled for the analysis of impact assessment methodologies, covering 17 different countries (Table 26). All 34 evaluations refer to R&D programmes run by EU member states, i.e. these programmes are covered in the ImpLore database. 12 evaluation reports refer to R&D programmes in third countries (USA, Australia, New Zealand, Switzerland, Norway, Canada).

Table 26: Number of analysed evaluation reports by country

Countries	*No. of reports per country*
Canada, Denmark, France, Hungary, Norway	1
Estonia, Switzerland, US	2
Australia, Belgium, Finland, Ireland, New Zealand, Sweden, UK	3
Austria	5
Germany	10
Total	*46*

Source: Analysis of evaluation studies.

All evaluation reports considered in this analysis deal with the assessment of programme impacts, though not necessarily focusing on innovation impacts in the narrow sense (i.e. the introduction of new products or new processes). A key selection criteria for considering an evaluation report for this analysis was if measuring innovation impact was among the evaluation's explicitly stated objectives. However, some evaluations failed to deliver findings on innovation impacts, particularly because the evaluation was conducted too early to assess any innovation impacts. This was typically the case with interim evaluations.

The following Table 27 shows the methodologies used in the 46 evaluation reports by country. One should keep in mind that this analysis is by no means representative for R&D evaluations in each country since only a deliberately selected number of programmes are considered. Our analysis of evaluation reports showed that a mix of both qualitative and quantitative methodologies is applied in most countries:

- *Interviews, desk research, document analysis and surveys* are frequently used evaluation methodologies in almost every country which were analysed. Desk research and document analysis can be seen as tools to gain basic information about the R&D programme and its context. By carrying out a survey, statistical data is obtained quickly and the views of the programme's participants can be captured easily. Interviewing programme managers or people that are related to the programme itself helps to generate a broader picture of the setting and context. Those methods are easy to apply and the evaluation team is supported with the basic information of the programme in a very sufficient way.

- The methodological approach of *case studies* can be found more frequently in countries with an advanced evaluation culture such as the Scandinavian countries, Austria, Germany, UK etc. Though this qualitative method is very time and cost consuming it provides a detailed insight into on-going processes. The case study method can be used for several purposes (Feller and Ruegg 2003):

    - to tell stories of people, organisations, projects,
    - to analyse underlying theories and
    - to provide illustrative examples of how a program works.

The principal limitation of the case study approach is that it gives anecdotal rather than quantitative evidence. Further on, findings and results arising from a case study analysis can not easily be generalised as other cases may show other results.

Table 27: Methodologies used in evaluation studies

	Qualitative methodologies					*Quantitative methodologies*				
	Interviews / Peer Review	*Case studies*	*Logic chart analysis*	*Network analysis*	*Desk research*	*analysis of monitoring data*	*Control group approach*	*Survey of beneficiaries*	*Econometric modelling*	*Cost benefit analysis*
Australia	☐				☐			☐	☐	
Austria	☐	☐	☐	☐	☐	☐		☐		
Belgium	☐					☐		☐		
Canada	☐		☐		☐	☐		☐		
Denmark	☐	☐						☐		
Estonia	☐				☐					
Finland	☐	☐			☐	☐		☐	☐	
France	☐				☐			☐		
Germany	☐	☐			☐	☐	☐	☐		
Hungary						☐				
Ireland	☐				☐			☐		
New Zealand	☐							☐		
Norway	☐	☐			☐					
Sweden	☐	☐			☐			☐		
Switzerland	☐	☐	☐		☐			☐		
UK		☐			☐	☐		☐		☐
USA	☐				☐	☐			☐	☐

Source: Analysis of evaluation studies.

- Apparently, *logic chart and (social) network analysis* are considered relatively experimental. The logic chart approach is a common tool for example in Austrian evaluation studies (see Zinöcker et al. 2005). In the 1970s it was firstly introduced in evaluation studies in the USA. Applied adequately the programme's rationale, design and achievement of intended results can easily be identified and communicated to the stakeholders.
  Network analysis is a useful tool to analyse the impact of R&D policies in order to assess the openness of networks to new members. By revealing linkages among researchers and organisations communication flows are exemplified in order to show how (tacit) knowledge is disseminated. Nevertheless, network diagrams only show relationships as of a specific point of time, such that repeating the analysis after a time interval is necessary to identify changes in the network over time. Thus cost

and time restraints can be limiting factors in the use of network analysis. (Feller and Ruegg 2003).

- Applying a *control group approach* is a very difficult undertaking. In our analysis, this methodology was only found in a German study. The *cost-benefit analysis and econometric modelling* needed a comprehensive framework of data regarding funded projects and participating enterprises for the evaluation of the US Advanced Technology Program (ATP). Although these approaches are useful to assess impacts they are not easy to apply as the necessary framework needs to be drawn up when the R&D programme starts its activities. Thus, data requirements need to be defined in advance which is not common in practice when designing or implementing a publicly-funded programme.

This analysis of methodologies applied in national evaluation studies in European countries showed clearly that there is no one single methodology to measure the impact of a R&D policy initiative. It takes a variety of methods to answer different types of evaluation questions. Thus, it can be assumed that a mix of methods allows for cross-checking the robustness of conclusions about the impacts assessed.

4.3.3 Country Cases of Good Practice

In this section, we present five country cases of evaluation practices that can be regarded as good practice examples for assessing innovation impacts of R&D programmes taking into account the inherent constraints to innovation impact assessment. Austria, Finland, Germany, Hungary and the United States serve as country cases. The five countries were selected in order to cover differences in country size (Germany and USA representing large countries, Austria, Finland and Hungary small ones), specialisation of innovation systems (USA and Finland as high-tech oriented innovation systems, Germany as focused on established technologies, Austria as a rapidly catching up country in terms of R&D intensity, Hungary as a representative of New Member States) and policy practice (USA, Germany and Austria as federal states, Finland and Hungary as rather centralised states). Furthermore, the five countries represent different traditions in their R&D and innovation policy.

Case 1: Austria

The number of Austrian public R&D interventions has risen considerably over the last ten years. Scrutinising evidence, accountability and impacts, policy makers and stakeholders are commissioning evaluations in order to gain information about R&D programmes and get recommendations on how to adjust or improve the interventions. Thus, the methodology and the quality of evaluation studies have improved and a number of new approaches such as logic charts, matched pairs, focus groups etc. were introduced. (Zinöcker 2007, p. 12) This development can partly be attributed to the work of the Austrian Platform Research and Technology Policy Evaluation which fosters the improvement of an evaluation culture by offering an exchange forum. In meetings and conferences current RTD policy issues are discussed. Afterwards, the results are summarised in a newsletter and disseminated to the interested community in Austria as well as across borders.

In Austria impact assessments have been mainly done as by-products within the scope of mid-term or ex-post evaluations of R&D policy measures (for example FIT-IT mid-term programme evaluation, mid-term evaluation of the Microtechnics programme). Especially in ex-post evaluations, which are often carried out too early, evaluation teams regularly experience problems such as that the funded projects are still incomplete and thus the effects are not yet realised, which makes it impossible to assess any impacts. Still, the impact analysis of the Austrian Science Fund (FWF) and the (former) Austrian Industrial Research Promotion Fund (FFF) are outstanding examples of institutions' evaluations in Austria. For the FFF/ FWF's impact analysis the concept of additionality was applied to analyse different aspects of enterprises that received funding. By applying descriptive and comparative statistical analyses of survey and secondary data as well as econometric models, the study addressed questions with regard to input, output and behavioural additionality. One of the consequences of this evaluation was the merger of several institutions into the Austrian Research Promotion Agency (FFG) which introduced, from the very beginning, an ex-post evaluation of its funded projects on a regular basis. Here, the economic impacts of the funds are assessed for a large number of indicators such as the technical and economic successes of the projects, commercialisation of project results, additional and maintained turnover, employment etc.

The *evaluation of the Austrian Genome Research Programme (GEN-AU)* can be regarded as a good evaluation example having implemented a thoroughly thought through methodological framework. It served as a basis for the decision of whether the programme should be continued in its present form. The evaluation team wanted to point out possible room for improvement of GEN-AU and provide the ministry with support when it came to adequately preparing a subsequent impact analysis. Using a wide-spread innovative mix of qualitative methodologies (i.e. logic chart analysis, international comparison, social network analysis etc.) paired with a plan for future monitoring and impact analysis, has given this evaluation worldwide recognition.[12] In fact, a more qualitative methodological approach was chosen to focus on processes and learning and still, for most of the funded projects, a considerable amount of time was left for completion.

The *logic chart analysis* can be regarded as the core feature of the evaluation and allows the reader to examine the programme on a single page. Depicted as a diagram it assists the user in visualising the connection between the mission, aims, activities, outputs, outcomes and impacts of a programme. It is also used for the future *monitoring and impact assessment plan* which is keyed to the programme's goals and activities. Future impacts have to be projected while bearing in mind that a prospective analysis gives rise to many uncertainties and risks. It is recommended to use risk assessment to determine whether objectives could not be achieved or results could not be implemented. Furthermore, the monitoring plan centres on selecting a feasible number of indicator metrics from each stage of the process leading to long-term impacts. In addition to the three sets of performance, for indicators which measure activities, outputs and outcomes, it is recommended to draw up performance standards to asses the degree of success achieved. Furthermore, the implementation of a future evaluation of impacts must be based on an intensive data collecting plan which defines what data to collect, when and by whom.

[12] The evaluation team presented its findings and recommendations at the annual conference of the American Evaluation Association in Baltimore in November 2007.

Finally, the evaluation team clearly advocated the continuation of the programme but also saw room for improvement.

Case 2: Finland

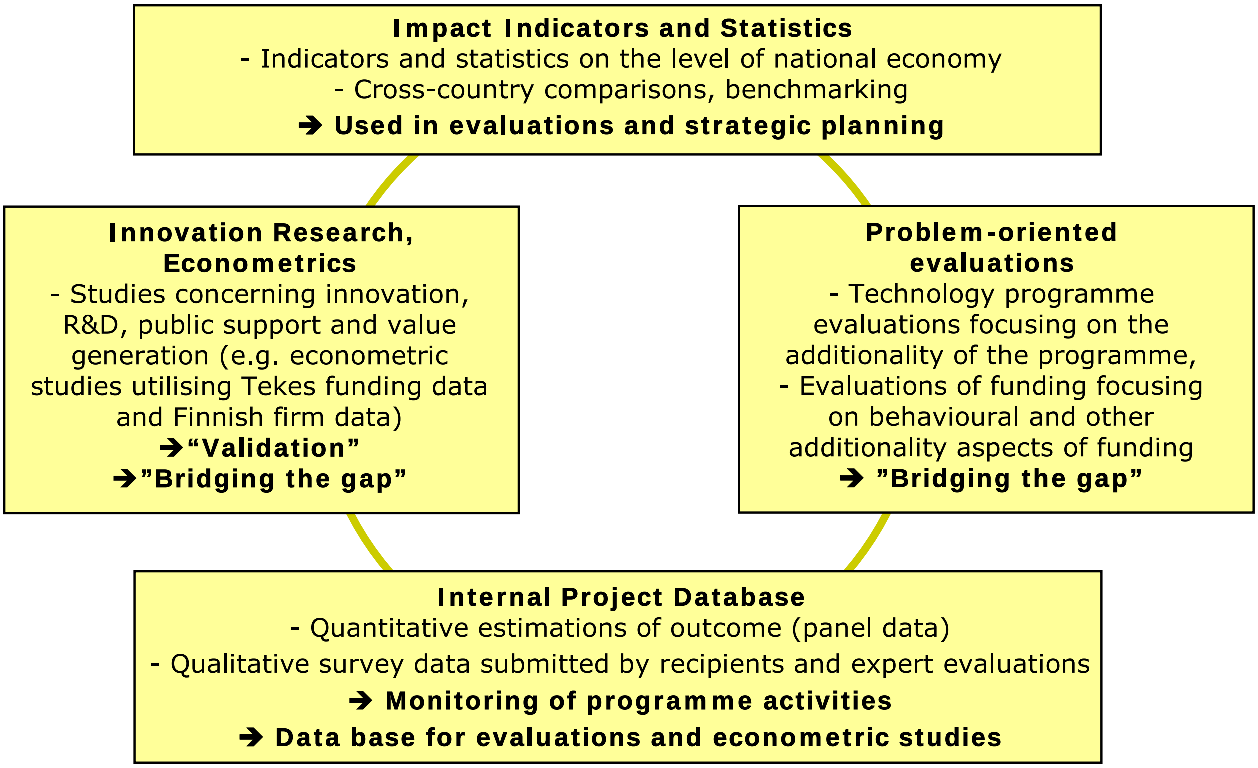
The Finnish government had put a strong emphasis on the technology policy of increasing public investment in research. These investments are aimed at enhancing industrial competitiveness and ensuring a strong technological basis by investing in high-quality applied research. The Finnish Ministry of Trade and Industry is in charge of the overall policy agenda, and the organisation TEKES is responsible for the implementation of policy measures.

Having being active in evaluation for more than 20 years the Finnish government has shown enormous capability for using evaluation results and lessons to design updated policies and programmes. Programmes, policies and the Finnish innovation system are systematically assessed, monitored and evaluated. One evaluation can also cover a cluster of programmes if they belong to the same field of technology or have similar goals. These inputs were used for developing an *impact model for the national agency for technology programmes, TEKES*, which plays a major role in encouraging innovation and evaluation in Finland. It is remarkable that the agency developed a professional unit for commissioning evaluation. It developed a *multi-dimensional database* which monitors the participants of their programmes. A proper impact assessment relies, in part, on a data collection strategy which monitors all projects of the agency. Starting the funding period with an estimation of the expected impacts in terms of turnover, export and employment by the participants of the programme, this self-assessment is reassured by TEKES project officers. During the course of the programme indicators are assessed in the middle and at the end of funding. Monitoring the programme and its participants as well as changes in the context of the programme is a prerequisite for a later effective ex-post measurement. Figure 26 shows main elements of TEKES' strategy to assess impacts of R&D programmes.

The chosen approach of TEKES addresses *impact assessment at the project level*. The ex-ante evaluation of projects relates to the assessment of specific targets which, according to the plan, have to be achieved by the funded participants. After the termination of the projects it is easier to attribute the impacts of R&D programmes.

In addition to the assessment of TEKES projects the evaluation of technology programmes has been established at three points in the programme. In the beginning of the programme a baseline is established and the outcomes are evaluated after the programme's termination which is then repeated again three years later. The evaluation results are used for managing TEKES, reporting impacts of R&D within the government, and to provide information to the general public.

Figure 26: Impact assessment of public R&D funding by Tekes



Source: based on Ahola (2006, p. 3).

Case 3: Germany

In Germany a much wider approach of the evaluation of innovation concerns is applied than in any other European country, because evaluation is regarded as a learning process. Looking at the evaluations carried out within the last five years an observed trend towards accompanying evaluations has emerged. R&D programmes are evaluated regularly during and after their life span and before a new or successor programme is implemented. Quite a number of evaluations, for example, evaluation of InnoNet, evaluation of the Microsystems Framework Programme, evaluation of ProInno etc., apply a combined ex-post and ex-ante approach in order to assess the hitherto performance of their projects and R&D programmes, as well for offering advice on the design of a successor programme.

The *evaluation of the German ProInno programme* can be regarded as a good practice example of German evaluations due to its applied concept of impact measurement. ProInno targets the enhancement of SMEs' innovation performance in order to foster their competitiveness in international markets. At the moment it is in its third phase of funding and 5.000 projects have been supported so far.

A three-modular evaluation concept was drawn up in order to evaluate this long-lasting programme. The first part dealt with the programme evaluation and its different subprogramme as well as the assessment of the programme management. Second, an impact assessment of funded projects was performed by applying a comprehensive methodological approach which involved the analysis of funding data, final project reports, a wide-spread survey and case studies. In addition a special analysis was carried out to assess the performance of non-funded enterprises.

The evaluation team tried to analyse the causal relationship of impacts and drew up the following indicators to identify impacts on three different levels:

- *Economic impacts:* the ratio between products/services/processes and sales and the development of sales
- *Increase of competences:* the enhancement of technological competences, the management of projects and co operations
- *Behavioural changes:* ongoing/increasing R&D activities, the tendency to cooperate

The last step of the evaluation comprised an attempt to scientifically accompany the successor programme ProInno II. Assessing the effectiveness of modifications compared to ProInno it aimed at giving advice on how to increase the programme's efficiency.

The programme was considered highly successful. Used as a basis for other programme evaluations, many other evaluation teams referred their work to this impact model. A qualitative data collection approach using interviews and case studies, combined with user surveys is the most commonly used method.

Case 4: Hungary

The case of Hungary is an example how evaluation practices are developed in the New Member States. Evaluation of R&D policy measures has been sporadic and irregular there. Tools for a strategic policy intelligence and policy learning, such as monitoring, evaluation and technology foresight, are used only occasionally, although it should be acknowledged that most of the programmes and institutions reviewed have not been implemented long enough to assess their impact properly. However, there is a need for a systematic evaluation, conducted by independent experts in order to establish what process type results and benefits have been achieved, and what should be done to improve the efficiency of the R&D programme.

In Hungary most of the current R&D policy measures are designed by government officials, with - or mostly without -the occasional assistance of external experts. Internal self-evaluation of policy measures, mainly conducted by those government officials who designed the measures themselves, are carried out whenever a decision is due concerning the renewal of a given measure (usually yearly). The results of these internal self-evaluation exercises are not published. State of the art methods of evaluation are not commonly used in practice. The evaluation reports address assessments of innovation and economic impacts, i.e. impact on employment or technological renewal, only in a few cases. Meeting high standards for evaluation reports with useful evaluation methods would imply the systematic use of external experts with high experiences or even expert from abroad.

Actually, there are two evaluation reports which deal with impacts assessment of R&D measures. The *evaluation of the Co-operative Research Centres KKK ("Supporting co-operative research and technology-transfer between companies and higher education")* focused on identifying cases of particularly successful activities, projects or participants in a programme. It is a simple demonstration of the virtues of a programme and the significance of its objectives. This programme evaluation discusses the impact of the established science–industry relationship assessing innovation activities of participating companies.

Another evaluation report of national R&D measures which addresses impact assessment is the *evaluation of the Pázmány Péter programme (so-called regional knowledge centres)*. The program aims to establish professional and regional centres of excellence in co-operation with companies and other research organisations in order to transform R&D results into marketable new products and technologies. In 2006 the evaluation of the programme concluded that it achieved major objectives and that the resources had been used quite efficiently. The evaluation study takes into account the impact of the program on future research activities in the form of the created critical mass, a number of written and edited publications, PhD dissertations, created new products and patents. The report also covers the assessment of innovation impact by newly established high-tech companies.

Case 5: United States

The US federal government and its agencies, the US research and innovation policy instruments are spread over a wide set of policy objectives and amount to more than 20 schemes. Programme evaluation is done on all type of policies. In the US evaluation practices often involve the implementation of indicators.

In case of the Advanced Technology Program (ATP), *assessment continues through the life of the project* in two forms. First, program manager teams perform visit reviews to assess progress in the development of the technology commercialisation. Second, participants of the programme agree to fulfil the *"business reporting system"*. Reports are collected from all participating firms, and then standardised and submitted electronically to create an evaluation database. ATP has been evaluated by an office of economic studies at the National Institute of Standards and Technology, where it is located. An external economist has been employed to develop case studies of the economic impacts of ATP projects. Data collection strategies at the outset of new programmes and monitoring during and after a program are necessary to have some baseline data available to measure the effectiveness of the programme. In the case of ATP, site visits and regular communication with programme officers are part of the monitoring procedure.

Summary of country cases

As mentioned several times in this chapter the assessment of impacts is a difficult endeavour which has several requirements. The requirements presented in the following should be, at best, be implemented in the beginning or during the course of a R&D programme cycle:

- The logic chart approach can be used as a core feature of an evaluation study as it perfectly visualises the rationale of a R&D policy measure and establishes a connection with its activities and impacts. Therefore, a monitoring and impact assessment plan, which is keyed to the programme's objectives, can be elaborated by using the results of the logic chart analysis.

- As shown in the case of Austria, Finland, and the US, it is crucial to project future impacts (for example, on the level of participants) although a prospective analysis gives rise to many uncertainties and risks.

- The implementation of a future evaluation of impacts must be based on an intensive data collection plan which defines what data to collect, when and by whom.

> Thus, a multi-dimensional database is drawn up in order to guarantee a monitoring of the programme and its participants. During the course of the projects, indicators are assessed in the middle and at the end of funding. A broad data basis is a prerequisite for a later effective ex-post assessment.

Especially in Germany, a trend towards accompanying evaluations has emerged. R&D programmes are evaluated regularly during and after their life span and before a new or successor programme is implemented (for example the ProInno programme). The evaluation concept consisted of three modules: a) programme evaluation including an assessment of the programme management, b) impact assessment of funded projects (paired with a control group approach) and c) scientific accompanying evaluation of the successor programme in order to assess the effectiveness of modifications.

In addition, the case of Hungary was shown as an example on how evaluation practices are developed in the New Member States. As the evaluation of R&D policy measures has been irregular and mainly driven by internal and self-evaluation practices it is obvious that external expertise is needed. Nevertheless, two evaluation exercises have been already carried out with a focus on impacts.

4.3.4 Conclusions

A comparison of national experiences in evaluating impacts of R&D programmes has shown that evaluation and impact assessment have become important management tools in policy making. In countries like in Canada and the USA, evaluation is a key element in a results-based management system and evaluation practices are carried out accordingly to improve the program management. This also has the advantage of better organisational learning and quality control.

The comparative study has identified some good practices for impact assessment. We see that usually impacts are defined in terms of direct outputs of research programmes such as the change in the level of R&D expenditure, the number of patents registered, or the commercial exploitation of the project results. Some additional effects have been measured at the level of the direct participants of R&D programmes. Few evaluation studies have measured the effects on the wider economy and society. Impact assessment is regularly undertaken in the USA, UK, Norway, Sweden, and Finland. Germany, France and New Zealand hardly ever use these more quantitative evaluation methods to assess the effectiveness of technology and research policy instruments. In the New Member States evaluation studies are considered to be success stories since a large number of the existing R&D programmes have been drawn up recently. At this stage the programme management prioritises data collecting and the development of a monitoring system.

4.4 Innovation Impacts: Results from a Focus Group Approach

This section summarises the main results from focus group (FG) discussions among policy makers, programme managers and stakeholders of R&D programmes conducted in ten different countries (Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Poland, Sweden and the United Kingdom). The aims of the focus groups were to identify the innovation impact of these programmes, discuss ways to improve the monitoring and evaluation of innovation impact and identify R&D programmes that can serve as good practice examples. The main findings were as follows:

- R&D programmes frequently pursue a variety of different goals, among which direct innovation outputs are – for the great majority of R&D programmes – not high-priority targets. Nevertheless, policy is increasingly expecting a greater contribution of R&D programmes to building up innovation competencies, capacities and capabilities of R&D performers.
- There are clear limits to the extent to which R&D programmes can be oriented towards the production of direct innovation output.
- Thematic programmes that support a specific technology are observed to have a relatively higher innovation impact.
- Small programmes with well-defined objectives and target groups were also reported to have a relatively higher innovation impact.
- A number of R&D programmes that can serve as good practice examples with respect to their impact on innovation specifically address science/industry collaboration.
- With regard to evaluation practices in Europe, most of the R&D programmes under scrutiny were evaluated. However, only few programmes are evaluated with respect to their innovation impacts.

In recent years quite a considerable number of evaluations of R&D programmes and initiatives in Europe have been carried out. However, the majority of evaluations seldom try to assess innovation impacts which were triggered by the R&D programmes and support the measures evaluated. Additionally, it is not an easy endeavour to compare methods and indicators applied by evaluators as the mixes of qualitative and quantitative methodologies differ, depending on the characteristics of the measures evaluated and the data available.

The ImpLore study dealt with these challenges in two ways: First, by collecting quantitative data on impacts by means of a self-assessment questionnaire and secondly, the -ImpLore study team carried out a series of focus groups to complement the quantitative data with qualitative assessments of R&D programme managers, industry representatives and experienced evaluators.

A comprehensive database was drawn up containing information on all publicly funded R&D programmes and initiatives in the European member countries (as already described in chapter 2). Unfortunately, it was not possible to collect consistent and comprehensive data on the design and management features and the innovation-related impacts of all R&D programmes contained in the database. Building upon the information collected for the database the ImpLore study team decided to complement the results of the database with qualitative information gained from a series of focus groups in a number of countries. The primary aim of the focus groups, which were carried out in a number of different countries across the EU, was to discuss the hypotheses linking the design and management aspects of R&D programmes to different innovation-related impacts. Additional objectives of the focus groups were to identify on one hand, ways to improve the monitoring and evaluation of innovation-related impacts and on the other hand, potential 'good practice' examples of R&D initiatives.

The method of focus groups is a well established method in the social sciences. Focus groups can be efficiently used to collect information by covering a relatively large number of interviewees in comparison to single face-to-face interviews. The particular strength of focus groups is that participants discuss their opinions and experiences and explain themselves to each other. The outcome of focus groups is often a kind of 'negotiation' of opinions where group dynamics play an important role. As different stakeholders such as ImpLore project programme managers, policy makers, industrial representatives, and evaluators share their opinion, the discussion does not only consist of individual contributions. During the focus group session the opinions of participants are articulated, defended and also collectively shaped through their communication with others. Since there is a tendency for the programme managers to overestimate the impacts from 'their' particular R&D policy measure, here the risk of bias is reduced by the involvement of different stakeholders. Within a short period of time rich and varied information on the topic is distilled. There is also a possibility that the different opinions of the participants lead the discussion to a new perspective and open up linkages which could not have been identified in more quantitative approaches such as surveys. In this vein, the participants of the focus group provided the ImpLore study team with an in-depth understanding of the programme effectiveness and its impacts.

Format and conduct of the Focus Groups

In the period from March to December 2007, focus groups were held in ten national settings. Two focus groups each were conducted in Austria, Germany and Greece. With the help of settings which were similar in all countries (with slight variations), four different types of stakeholders in the programmes were represented:[13]

- Policymakers from the host country, particularly those known to have played a significant part in the formulation of policies involving the launch of one or more national R&D programmes.
- Policy analysts and programme evaluators with broad-ranging experience of the design, management and evaluation of R&D programmes in a range of different settings.

[13] A description of the approach including the concrete interview settings is given in additional papers produced in the context of the ImpLore project (see Appendix 6 'A Guide to Focus groups' and 'Focus groups Briefing Paper' respectively').

- Local programme managers with extensive experience resulting from their involvement in the management of one or more national R&D programmes.
- Representatives from the business sector who gave insights into how they perceive application and funding procedures of the R&D programmes and hints on impacts.

With the exception of Belgium (where 'mini' focus groups were carried out to cover different regional dimensions) between 6 and 10 stakeholders were brought together.

The first step in the process was the distribution of the briefing paper, designed to familiarise attendees with the goals of the project and the purpose of the focus groups. The meeting was opened by an ImpLore team member and in the beginning the participants introduced themselves and described their relevant experience. Each focus group lasted for approximately three hours. After asking the participants to name the national R&D programmes which could be considered as good practice examples, the focus group session was mostly structured in the following way:

- *Session 1:* the participants were asked to sort out the design and management criteria of research programmes that have had the highest impact on innovation.
- *Session 2:* the participants were asked to discuss how the impact of research programmes is assessed in their country. In particular: what were the most important management, evaluation and monitoring techniques in order to achieve a high innovation impact with a programme?

In the following, a summary of the main results is provided (for a more comprehensive coverage of the focus groups, see Appendix 6).

4.4.1 Defining and operationalising innovation impact

A striking observation was that the notion of 'innovation' itself gave rise to quite some debate in the majority of focus groups, though the standard definitions of innovation were provided to the participants upfront (based on the latest version of the 'Oslo Manual'). Moreover quite a number of programmes themselves had at least some form of potential innovation output included in their project selection criteria. These ambiguities (even among experienced and articulate experts in the domain) can – in our opinion – be traced back to several causes which will be elaborated in greater detail in the sections below:

- Participants were quick to point out that – at least for the large majority of programmes – innovation was not the main target of the programme. One could hypothesize that – as compared to the metrics for the prime output, namely R&D – less effort was invested in defining and operationalising innovation output measures. There was thus both ambiguity and uncertainty among programme managers as to which concept of innovation to use. These concerns can be interpreted against the background of the multi-goal orientation of R&D programmes, bearing in mind that innovation is not the primary target of most of the programmes reviewed.
- In the same vein, various stakeholders suggested using a wide definition of innovation output instead of merely focusing on direct product and process innovations

(sometimes they went as far as to describe the discovery of a new scientific method as an 'innovation'). A suggestion quite often put forward was also not only to consider successful innovations as 'innovation impact' but to include the *innovative behaviour* and the impact of the programme on the various dimensions of this behaviour (for example, collaboration, change in the nature of projects etc.) as an appropriate measure for the impact of the programme.

The assumption that most of the R&D programmes do not primarily target innovation was confirmed in several focus groups. Many programme managers stated that their programme primarily improves the *preconditions* for innovation and the *capacities* to innovate later on, and only to a lesser extent leads to direct innovation outcomes *per se*. R&D programmes tend primarily to improve the capabilities of participating enterprises to innovate. In most programmes there is a focus on the area where 'innovation is triggered' as it was labelled.

An observation shared by many programme managers was that in the past 15 to 20 years, R&D programmes have had a tendency to increase the number of targets and goals (including innovation related targets) and also to increasingly support different phases of R&D. R&D programmes that foster the early development of technologies particularly aim at raising the industry's awareness of technology fields that might be of economic relevance in the future. Other R&D programmes support later stages which involve the development of prototypes.

In a few focus groups, programmes were identified that directly target and have a direct impact on innovation. However, the impact is generally quite low and often deliberately so: These programmes primarily address a specific target group (for example, SMEs) and support the people on the 'cutting edge' who would not otherwise carry out R&D. In this respect, the issue of "scalability" of the programme – or rather the limits of it - was brought up: the target group is often quite small and it cannot be reasonably expected that an extension/enlargement of the programme will lead to a proportional increase in the overall innovation impact of the programme. Here, in order to enhance the innovation impact, the task for programme design and management is to first and foremost correctly specify and identify the target group.

Stakeholders from various contexts (programme managers, policy makers, experts), also identified a number of different ways in which the innovation impact of R&D programmes could be improved. From various examples of programmes it seems that substantial improvements could be made in the overall programme design, implementation and monitoring/evaluation procedures. Pointers in this direction are given below. However, it is fair to say that most of the suggestions would improve the effectiveness and efficiency of R&D programmes with respect to achieving their goals and objectives *in general* and not solely with respect to innovation output. For example, the involvement of stakeholders in the various stages of the operation of a programme (design, implementation, exploitation) will in all likelihood also increase the effect on innovation alongside the beneficial effects it can have on goal attainment in general.

Having said that, it also became clear from the focus groups that most stakeholders also see clear limits to the extent to which R&D programmes can be oriented towards the production of *direct* innovation output.

When comparing different types of programmes with respect to their potential to trigger innovation, various assessments were put forward by the focus group participants:

- *Thematic (i.e. technology specific) programmes* were said to have a potentially higher impact on innovation output because of their focus and the involvement of industry (which is more intense in these dedicated programmes). But even in this type of programme, a new generation of programmes has come into being, focusing more on collaboration and networking (i.e. more on behavioural additionality) and less on direct outcomes in the form of concrete technological solutions, as was the case in earlier programmes. Thus it might well be that the perception of a higher innovation impact could be attributed to this new feature of R&D programmes.

- *Small programmes* with well defined objectives and target groups (and quite often little R&D content) also appear to have high innovation impacts, but are not scalable, i.e. they should not be expected to show impacts beyond their narrow target group. The R&D programmes that are most likely to have a large impact on innovation are probably those that 'push firms over the edge of R&D', that is, to incite them to engage in R&D for the first time, even on a small scale.

- Repeatedly, the need for "holistic programme portfolio management" was stressed as a means to increase the overall effectiveness of R&D and innovation programmes. Individual programmes address different stages of the R&D and innovation process, which sometimes ovelap, sometimes leave gaps, and sometimes provide conflicting incentives to R&D performers. Hence, it was felt that combining these initiatives under one umbrella (for example, a programme with different subprogrammes or initiatives) could be a means to increase coherence between measures. In the same vein, a better involvement of all stakeholders at all stages - from the start of the programme design to acting on feedback and the recommendations of programme participants could contribute to programme coherence and thus increase their effectiveness.

4.4.2 Design and Management Criteria with an Impact on Innovation

The participants of the focus groups were asked to name the design and management criteria of R&D programmes that have had an impact on innovation. Some topics recurrently emerged, the most important of which are described below.

Design Criteria

In the course of all focus groups three main areas were identified that should be considered when designing a R&D programme:

- defining the programme's objectives clearly
- seeking networking effects with existing programmes
- involving (external) parties in the design process (though the extent of 'optimal involvement' was a matter of some debate).

An overwhelming majority of the participants agreed that every programme design should include a *process of defining clear and specific objectives*. These should be transparent, realistic and have to be kept simple as they should be understandable when communicating them to programme applicants. It was also mentioned that a 'goal overload' of the programme should be avoided, that is, it is important not to pursue overly diverse targets. This could be read as a warning against including too many innovation oriented goals in R&D programmes.

Another aspect mentioned was the *flexibility* to change the specification of goals/targets in order to allow learning processes to improve the programmes during the period of operation of the programme. It was said that programmes have to be 'open' to a certain extent, since framework conditions are change frequently, sometimes making it necessary to adjust the targets.

Ex ante evaluations are an important instrument to assess the need for policy interventions and the potential impact of the programme and its design in advance. In the Austrian focus group one programme manager reported that his/her programme was evaluated ex-ante in order to approach a broad scope of involved areas which go further than research and development. Such an evaluation triggers many ideas for improvement of programme design. It was reported that a considerable number of aspects brought forward in the evaluation report have materialised during the programme's life span.

Participants of the focus groups proposed paying attention to spillover effects at an early stage as a means to increase impact of the programmes. They were particularly referring to networking effects, which should be sought with other programme participants when defining a programme's objectives.

Another observation was that programme's participants often advance to the next stage in the innovation cycle during the life span of the programme, as most of the R&D programmes span a considerable length of time, from basic research to close-to-market research and development work. Hence, programmes should be designed with a view to complement other programmes and seek network effects with existing ones. In this context the demand for holistic portfolio management is on the rise among programme managers. The impact assessment should therefore take the different areas and development stages within programmes into account. For example, in 2006, the Ministry of Economic Affairs in the Netherlands introduced a new type of policy instrument called the 'programmatic approach' (see Technopolis 2007). A part of this programmatic approach is the trend towards subsuming a mix of inter-related instruments within the umbrella of one programme. For example, the Energy Research Subsidy involves different modules under one programme umbrella and addresses different phases of the innovation chain, ranging from basic research to close-to-market activities. This hints to a careful selection of the 'unit of analysis' for impact analysis as a 'programme' can have very different breadth and scope.

It was also stressed that various types of stakeholders, such as industrial representatives, users and scientific experts, should be involved in the design process of a programme. While such an involvement is likely to raise the effectiveness of a programme in general, bringing in business representatives specifically enables programme managers to adjust the programme's aims to industry needs and hence enhances the potential for innovation impact. Such an approach has already been implemented in the design and management process of many Dutch programmes. Furthermore, a more forward looking approach was suggested by one participant, who recommended that projects could be co-managed and selected by business representatives and users. The idea of involving the programme manager in the set-up and design was also considered – if the programme is going to be revised – as they have an intensive and long-lasting knowledge of the programme itself.

It was also remarked that a short-term perspective with respect to innovation impacts requires a different programme design than a long-term perspective. The participants suggested some measures which have been shown in some cases to have the potential to increase short-term innovation impacts of R&D programmes:

- *Marketing and commercial exploitation plans*, if already part of the programme design, would positively affect the likelihood to launch innovative products or services from the project carried out in the respective programme.
- *Rules for technology transfer* (including IPR rules) should be laid down in advance.
- A *"translator function"* should exist, that is, somebody who "translates" the perspectives of the different participants (for example, this function was often performed by industrial PhD students)

Management Criteria

In the focus group sessions a number of characteristics of programme management conducive to better performance of the programme were mentioned, such as stability, regularity, and reliability etc. At the same time it was frequently stressed that the programme management also needs flexibility to modify the initial targets and modes of operation of a programme and tailor them if needed to the changing requirements of the beneficiaries, of policy and the economy at large.

It was highlighted as a main prerequisite of the success of a programme that funding of the projects should be consistent, regular, dependable and programme management should be easily accessible. Companies should be provided with a framework that allows for the strategic planning of R&D projects. Keeping this in mind, it is important to determine and communicate objectives and indicators for the selection and assessment of projects with great clarity in order to facilitate project proposals. This can be achieved by

- supporting applicants and beneficiaries with *intensive monitoring/coaching* where they can directly address their problems to the responsible programme manager (SMEs in particular are often overstrained by administrative efforts)
- offering a *pre-screening of project proposals* in order to help enterprises ascertain which funding programme best fits their needs
- providing a *'toolbox' of support instruments* with simple, transparent rules for application procedures
- avoiding long *waiting periods* for the final decision to accept or reject individual projects

A clear chain of responsibilities within the funding agency is necessary and is seen as essential to make use of tacit knowledge provided by the programme managers.

Throughout the focus groups the participants agreed that continuous project monitoring and regular programme evaluations are necessary controlling instruments to assess impacts on innovation. The evaluation and monitoring framework should be set up early, during the design phase of the programme, and be subject to continuous adoptions and modifications during the programme's life span. Specifically, interim evaluations of projects should already include an assessment of a potential commercial exploitation of innovation results.

How to measure impacts both in ex-post and interim assessments was another fiercely debated issue. The assessment of innovation impacts in the context of programme evaluations is discussed in detail in the following section of this report. It was mentioned before that indicators need to be adapted to the size and budget of the projects as cost-benefit aspects play an essential role. The focus groups identified a number of further measures that may increase the exploitation of results from R&D projects:

- demanding plans for the exploitation in the ex-ante project assessment criteria
- introducing (soft) indicators to measure product and process innovations and facilitate monitoring in addition to the scientific indicators
- committing beneficiaries of the R&D programme to support the programme management by providing data for a set of indicators lasting an agreed number of years after the termination of the funded project
- providing monetary stimuli for innovators to exploit their research results

It has to be mentioned, though, that some of these proposals were controversial. For example, the proposal to provide extra funding for the exploitation of innovations was seen as overstated for some participants. They maintained that such measures should be the realm of dedicated innovation programmes rather than R&D programmes.

As mentioned earlier, evaluations of R&D programmes' innovation impacts are rarely found. This can partly be attributed to the fact that evaluations struggle with the problems of timing (when do impacts appear) and attribution (how can impacts be related to particular projects/programmes). Another important determinant of impact analysis is the chosen methodology. Here, a considerable variety of approaches can be observed, which in turn make a comparison difficult. This question will be dealt with in more detail in the next section.

4.4.3 Identification of Innovation Impacts

Where to look for innovation impacts?

Firstly, it was a generally shared observation that the identification of innovation impacts is very difficult for a number of reasons: Most programmes run over a period of five to ten years, and innovation impacts take roughly a minimum of three years to become visible after the end of the R&D programme especially when strategic/basic research is involved. Thus, on-going programmes can hardly be appraised in terms of their innovation impacts.

Regarding the timeframe appropriate for the identification of innovation impacts of R&D programmes, views varied considerably. While some participants advocated for a ten year evaluation period, which seemed suited for R&D projects aiming at scientific breakthroughs or enhancement of the knowledge base of participants, this view was not generally shared, especially by the representatives of funding bodies, who claimed that for a large number of projects, innovation impact should be visible within a shorter period of 3 to 5 years, given the nature of the projects in most programmes.

Secondly, it was said that programmes span a considerable range of activities, from basic research to rather close-to-market activities. It is therefore hard to attribute impacts to a particular programme or initiative, with programmes quite often supporting and complementing each other. For this reason, it was stated that evaluation is best done not in isolation (for each individual programme) but from a systemic perspective. In one focus group the proposal was brought forward that evaluations should to be carried out across technological areas and contextual environments in which R&D programmes exist. For example, in the UK a systematic process is being implemented from 2007 onwards, to evaluate the annual economic impact of the Research Councils' work.

Suggestions were made to look primarily at *specific projects* in order to measure innovation impacts (especially true for large-scale mission oriented programmes). The programme management usually has a good knowledge of the success of particular projects. This knowledge depends on the continuity and regularity of monitoring data as well as the indicators that are called in by the programme management.

In general, policy makers are responsible for the assignment of evaluations, but some participants of the focus groups in Greece and Poland claimed that the public officials and/or programme managers are not skilled enough in this area due to lack of experience. Another problem was raised by a Belgian focus group participant, who pointed out that the responsibilities for evaluating the impact of programmes have not been incorporated into job descriptions for scientific administrators. Unless responsibilities and obviously, budgets are assigned to this task, impact evaluations of programmes will continue to receive insufficient attention.

Despite the fact that most of the programmes do not primarily address innovation *per se,* the participants of the focus groups identified important indirect effects related to R&D programmes which should be taken into account when assessing innovation impacts:

- One of the most important impacts mentioned was the development of networks by the publicly-funded R&D programmes. This refers not only to the creation of science-industry linkages for one particular project, but also networking in the sense of taking advantage of spillovers that arise from an interdisciplinary collaboration between different projects and programmes.

- Within science-industry collaboration, the increasing mobility of labour between sectors was considered as a significant impact, for example, when doctoral students are employed by the industry or researchers move to the industry in the aftermath of a collaborative project.

- The fact that the universities' awareness of collaboration with industry is raised and *vice versa* is a considerable effect of R&D programmes. Trust building has an important share in this process.

- Besides the networking effect, participating in R&D programmes also enables enterprises to screen new technological fields more easily, since the programmes provide the necessary infrastructure and improve local conditions for innovation. An achieved innovation (for example a prototype, demonstration etc.) enhances the company's visibility.

- Furthermore, the creation of new knowledge was stated as an impact of the programmes which affects innovation indirectly as such knowledge is disseminated and subsequently put into use. To this end, most of the participants of the focus groups maintained that R&D programmes should primarily aim at high standards of scientific quality.

Different national approaches to assess innovation impacts

When assessing innovation impacts, the choice and mix of methodologies is crucial. There was general agreement that an appropriate evaluation approach must combine quantitative and qualitative methodologies. In the different national focus groups some examples were mentioned that illustrate how evaluations are carried out in their countries:

In the **Swedish focus group** it was stressed that policy makers often seek one single indicator to measure impacts. While it was said that there might still be room for improvement in assessments using quantitative indicators, one should be aware of the shortcomings of those indicators. For example, it was argued that one proper way to evaluate R&D programmes is based on methodological triangulation and is thus a mix of

- cause and effect logic,
- a quantitative approach and
- a qualitative approach building on case studies.

Using a mix of these methods, rather than only one single indicator, provides a more comprehensive picture. A consultancy participant reported from his experience that they mixed peer review with qualitative case studies based on interviews in order to understand the conditions from a systemic perspective. Case studies can provide explanations and increase the understanding of processes, system failures and mechanisms.

A Swedish funding agency has formulated a *policy regarding evaluations*. The policy sets out three different, but complementary, goals.

- The first goal is the operational goal, which means taking care of current investments, learning from mistakes and improving the work.
- The second goal is the strategic goal, which means analysing the forms of investment and the actors/organisations involved in the projects to provide a policy background/base for programme leadership.
- The third goal is the existential goal, which means that they can justify their investments to the government in terms of longer-term effects, for example, finding out. which mechanisms were important.

In the **UK** evaluations are increasingly systematic and systematically-collected data is becoming more common. It is difficult to measure long term socio-economic effects, economic spillovers and wider benefits, but quantitative information is improving with the right type of data collection. Programmes are increasingly being initiated on the basis of a business case, with a cost-benefit analysis and measurable targets, so the quantitative metrics are defined from the beginning.

In the **Netherlands** innovation impact has not been evaluated systematically in the past, but rather by considering examples on a case-by-case base. The tradition is more to monitor the research input, to measure the research output in terms of the number of publications, to calculate the number of successful PhD's and, for instance, calculate the number of PhD's appointed at a firm after the project.

In **Germany** the typical form of evaluation is to ask the beneficiaries whether they profited from the programme. One of the participants suggested that best practice in programme evaluation would include auditing by external parties, control groups, and an appropriate methodological approach between top-down and participative evaluation.

Furthermore, one of the participants raised the methodological issue that input-/output-analyses are rarely offered by evaluators. It was suspected that the reason might be that efficiency of funding is difficult to measure. The number of patents was regarded as a weak indicator for innovation, although it is frequently used in practice.

Evaluation and measuring the impact of programmes has been considered by various **Belgian** administrations as a major challenge. They referred to the high cost of conducting programme evaluations, financially and in terms of time, as well as the lack of well-adapted methodologies and indicators, as prohibitive factors.

The **Austrian** Platform for Research and Technology Policy Evaluation[14] recommends in its Evaluation Standards a mix of methods which are derived from the content of the respective programme (or institution, or policy area) and should be laid down along general lines in the Terms of Reference. Evaluators are often under considerable pressure to come up with quantifiable results, which, however, alone cannot provide an adequate basis for strategic policy decisions. Thus, they should be encouraged to complement their findings with extensive, descriptive information and try out new methodological approaches.

The current compendium 'Evaluation of Austrian Research and Technology Policies' summarises evaluation studies compiled in the field of research and technology policy over the past five years. More than 50 evaluation reports are listed. They primarily apply a mixed methodological approach. Only a few impact assessments of programmes or institutions can be found which rely to a considerable extent on quantitative methods such as econometric models. But Austrian evaluators are also trying out new methods such as social network analysis, logic chart analysis or pilot studies.

The Ministry of University and Research in **Italy** has established a comprehensive database of R&D and innovation projects. The database is used for the monitoring and assessment of activities. A full set of evaluation, assessment and monitoring tools was set up in order to ensure that proper control measures are taken and feedback is given on funding initiatives. Each funding instrument provides monitoring and evaluation rules and mechanisms for ex-ante, mid-term and ex-post. The deployment of these instruments and the feedback that is generated on the programme set-up and the policy design determines the development of public intervention in the fields of R&D and innovation.

[14] www.fteval.at

Nevertheless, there is no unified approach to R&D programme evaluation, which basically works on an autonomous basis. A unified view is achieved at a later stage through integrated reviews of evaluation reports.

4.4.4 'Good Practice' Examples

Having defined the notion of 'innovation impact', the participants of some focus groups were still hesitant to name programmes which can be considered as good practice examples. They hesitated because they felt that most of the R&D programmes have not been designed with the primary objective of producing innovation outcomes.

In the following R&D programmes that might be considered as good practice examples in terms of generating innovation impacts are discussed for those countries in which focus groups were able to identify such programmes (Greece, Sweden, Austria, United Kingdom, Germany, Italy, France, the Netherlands). In addition, programmes that can be regarded as good practice from countries other than these five are presented in boxes. These come from the New Member States as well as from third countries (USA, Canada, Norway). Information on them has been gathered through the network of country experts and desk research.

Greece

The participants identified four national R&D Programmes that have had the greatest impact on innovation:

Support for Research and Technology Parks and Incubators- ELEFTHO

This programme is considered as an example of good practice as it promotes co-operation between industry and research entities in long-term research and technological development projects, in order to produce innovative products or services and confront social and cultural needs that affect the competitiveness of the economy. The projects are undertaken by consortia of enterprises, research centres, educational institutions, non-profit making organizations and other interested entities, with the aim of increasing the competitiveness of enterprises (primarily SMEs) as well as economic competitiveness in general.

The objective of the programme is to create economies of scale in view of exploiting new knowledge, through the development of knowledge-intensive business incubators and scientific and technological parks. Furthermore, it aims to provide support to newly established spin-off companies and bolster the participation of technological parks in the equity capital of the said companies. The programme will support new incubator structures and R&D parks, which will be subject to substantial participation by private investors. Finally, the programme design addresses the participation of innovative companies. This is the only programme in Greece that primarily targets the production of innovation outputs.

Poland: Support for Science and Technology Parks and Incubators

A similar programme exists in Poland. Support for science and technology Parks and incubators has emerged as an Agency's (PARP/PAED) own initiative, inspired by another Agency's programme (ARP – Agency for Industry Development). One can regard the ARP initiative – Support for Industrial Parks – as the programme's indirect forerunner. This programme aimed at industrial parks – created as successors of previous state owned companies, usually monopolists who went bankrupt. The PARP/PAED initiative can thus be regarded as the next step aiming at technology parks, which implies a technology focus, a science involvement etc. The rationale of the proramme can be summarized as a support for Science and Technology Parks and Incubators – enhancing business-science and science-administration cooperation.

The programme has a national focus. The authority responsible is the Ministry of Economics, the managing body is PARP/PAED. Eligibility criteria allow only local administration, public research organisations and applicants with a certain track record (for example, previous experience in already existing parks) to participate in the programme, which is not open to foreigners. The total budget is €620,000. The maximum public budget for each project totals approximately €70,000; the minimum is €.9,000. Private co-funding is not required, but initiatives that proposed including their own funds scored higher during selection procedures. The selection criteria stress the likelihood of success, the exploitation plan, and management quality. It should be underlined that innovation criteria were quite important and that the involvement of universities/scientific institutes led to higher scores. Activities covered under this programme include mainly soft actions which include the preparation of: 1. feasibility studies, 2. business plans, 3. estimations regarding impact of future investment on the environment. Projects related to knowledge and technology transfer received were preferred for funding. The projects are monitored almost on a daily basis, including continuous PARP involvement and engagement. Accountability is obligatory, legal measures are envisaged in case of maladministration and other abuses, but results of the project assessment are available only to the parties involved. Publications serve as an impact indicator. The whole programme is evaluated ex-ante and ex-post by a programme management agency. The assessment refers to case studies as well as to analysis of monitoring data.

The impact which can be expected from this programme in the short and medium term is mainly knowledge transfer. In the long term intensified science-business cooperation is expected. The activities covered under this programme are mainly soft actions, for example, the preparation of a business plan. The next step, which is the realisation of the initiative, falls under the responsibility of the ARP. This will contribute to further fostering a culture of cooperation and setting up new parks and incubators. It should be stressed that almost 80% of those who completed their feasibility studies ("soft" studies), later applied to ARP for support in executing the business plans. There seems to be a lack of direct reference to the R&D sphere, although the strong emphasis on innovations is pervasive. Here the agency acts as a broker, mediator and facilitator.

Bearing in mind the Polish paradox of a well-educated young population and high level of university research on one hand, and low scores in R&D rankings, lack of propensity to innovate and negligible registered patents on the other; one can regard this programme as a crucial bridge between the academic and business worlds, which will hopefully bring about more future innovations. As mentioned, PARP/PAED's main activity and task is to support entrepreneurship, which includes encouraging and facilitating innovations. There have been many initiatives and actions undertaken in this respect. Although innovation issues are at the top of the PARP agenda, there seems to be no clear link to the R&D sphere.

a) The Polish Agency for Enterprise Development (PAED) is a governmental agency subordinate to the Minister of the Economy. It was established by the Act of 9th November 2000 for the establishment of the Polish Agency for Enterprise Development. Its task is the management of funds assigned from the state budget and the European Union for the support of entrepreneurship and the development of human resources, with particular consideration given to the needs of small and medium sized enterprises (SMEs). PARP / PAED is among the institutions responsible for the implementation of activities financed from the Structural Funds.

Joint ventures for research and technological development in sectors of national priority

The rationale of the programme is to increase collaboration between the various actors in the National Innovation System, especially for R&D actions with a long-term perspective. This programme covers both the priority axes of the European Community and the Greek market's needs. There are also a wide variety of the companies that participate for example, small/ medium-sized/ large companies, non-profit organizations, public institutions etc.

We consider this programme as an example of good practice because it implements a mix of practices between industrial and competitive research and mostly targets innovation processes. The support stops before the production of a commercial outcome. The perspective of product commercialization exists but is not given much emphasis. The evaluation of this programme has yet to be completed.

Programme for the development of industrial research and technology (PAVET, PAVET-NE)

The rationale of the program is to encourage the development of industrial research, emphasizing pre-competitive research in Greek enterprises. The programme is open to all sectors. Its focus is achieved only through the "market" (bottom-up approach). Innovation is sometimes promoted directly, but mostly indirectly. The transfer and adaptation of advanced technology to traditional industrial sectors and the development of industrial innovation activities contributes to the improvement of the business productivity and the development of new or improved methods of production. The main objectives of this programme are the development of new, improved and innovative products or services with a high added value, the improvement of business competitiveness and penetration into new markets. This program aims at industrial research and pre-competitive growth, which goes a step further than industrial research, intending to develop a product or a process. We consider this programme as an example of good practice because of the large number of successful patent applications up to now, which is also the main reason to categorize this programme as an innovative effort.

One difficulty that has been identified is the lack of strong objectives. Also, not many evaluation reports have been completed.

Greek Research and Technology Network (GRNET)

This programme supports the research and development of Information and Communication Technologies (ICT) within Greece and internationally through the provision of its high-capacity networking and grid computing infrastructure, the strengthening of e-Learning & e-Business practices and the participation in international research and education efforts. This is an applied programme which is very close to the market in its approach. It thus has an impact on innovation almost by definition.

Estonia: Innovation Awareness Programme

The Innovation Awareness Programme in Estonia is a quite novel and unique one in Europe. Similar programs are rare in other countries (although the respective strategies do exist). However, the idea for the program developed mainly in Estonia, with the help of Finnish experts. The programme goal is to raise the general awareness of innovation as a key factor of economic growth. Moreover, it attempts to strengthen the skills and knowledge of the academic and business sectors and thus allows a smooth implementation of innovation projects. Although it was launched only about a year ago it has already received a good response from a range of beneficiaries. The program has an amplifying impact on all other R&D programs in that it raises the general awareness of policy-makers, administrators and industry players and hence strengthens the whole national innovation system. Thus, it may be regarded as a multiplier programme.

The Innovation Awareness Programme could be identified as an example of best practice in terms of a good solution for supporting long-term R&D activities by raising the general awareness of innovation as a key factor for economic development.

Sweden

Competence Centre Programme

The participants of the Swedish focus group considered the Competence Centre Programme as a best practice example with a high impact on innovation. There are 28 competence centres in Sweden. They exist in universities and provide a place for industrial and university researchers to collaborate. These centres are financed by industry, the university, the Swedish Agency for Innovation Systems (VINNOVA) and the Swedish Energy Agency. It was argued that the competence centres have been especially successful from a systemic perspective with respect to increasing the links between firms and universities. An impact (effect) analysis after eight years revealed a number of impacts: positive impact on the universities with regard to industry collaboration, fostering of a kind of 'centre thinking' with a critical mass of members of research groups, the competence centre functioning as a base for recruitment of PhDs to industrial firms, networking effects, commercial results in excess of the investments, and localisation effects of industrial R&D.

The question about the characteristics of the Competence Centre programme that make it so successful was raised. It was discussed that each competence centre is very well planned and prepared.and they are closely monitored after they have been established. Moreover each centre is a collaboration (even financial) between three parties and there are negotiations involving all parties about the actual content of the R&D conducted at the centre, leadership of the centre etc. The focus group argued that another important factor behind the programme's success is that it is a long-term commitment, which protects it from short-term interests.

Vehicle Research Programme

Another programme that was mentioned is the Vehicle Research Programme and similar programmes focusing on traffic injuries. These programmes run over very long time periods (1971 – 2004) which has allowed their impacts to be measured. Thus, the impacts on society can be quantified.

Latvia: Market-oriented Research Programme

A good practice R&D programme in the New Member States that fosters science/industry collaboration is the "Market-oriented Research Programme" in Latvia (MORes). MORes is a special programme for basic & applied research aimed at promoting the integration of science and industry, the introduction of research results to industry, the development of knowledge-based industries, the development of technologically oriented SMEs, an improvement of quality assurance systems and the creation of new jobs in knowledge based sectors.

The goal of the programme is to encourage researchers from universities, research institutes and SMEs to develop new competitive products and facilitate the development of new start-ups. The programme has been up and running since 1993 and has an open end. It should be stressed that this programme emerged as a first policy measure to promote the integration of science and industry during a turbulent transition period from socialism to market economy. For more than 10 years it has practically been the only policy measure to promote science-industry cooperation. New measures with similar aims have only recently been developed. The implementation of more activities of this kind is planned during the next planning period of EU Structural Funds 2007-2013.

The programme founder and managing institution is the Ministry of Education and Science of the Republic of Latvia, which is the leading public administration institution in the Republic of Latvia in the field of education and science, as well as in the areas of sport, youth and state language policies. Within this programme, every year the Ministry of Education and Science finances approx. 90 market oriented research projects. These projects are mainly carried out in state research institutes and universities, partly in innovative SMEs. Projects are funded if a substantial part (~ 30%) of the total project costs is covered by an industrial firm or another partner. This approach intends to stimulate researchers to prepare project applications, which are vital to industry.

Funding is allocated to applied projects and is not limited to specific science disciplines. However, the programme has a technology focus - so far approximately 60% of the whole programme budget has been given to technology (engineering sciences) projects. Besides the technology sector, projects in natural sciences, biotechnology, forestry and agricultural sciences have also have been funded and have attracted reasonable amounts of the resources involved. The programme covers the territory of the Republic of Latvia and all the applicants should be Latvian residents. Moreover, the projects can be implemented in scientific institutions, which are listed in a register of scientific institutions. The annual budget has doubled since the start of the programme, however, during the last 5 years it has been within the range of €1.2 – 1.4 Million. Maximum state co-funding is €0.3 Million per project. The projects are co-funded by the private sector; the minimum level of private funding is 30 % (it was 50 % until August 2006).

Project selection is carried out by experts from the Latvian Council of Science and takes into account the applicant's scientific qualifications and experience in the proposed field, the scientific justification of the project, competitiveness and novelty of the scientific idea, as well as the potential to achieve results. The potential of the research and financial estimates are also borne in mind. The economic evaluation assesses the financial potential of the cooperation partners to provide co-funding, the feasibility of the cost estimates, the project's potential to achieve its defined goals while taking into account existing market conditions and business plans, and the importance of the proposed project for the development of the national economy.

Each individual research project supported by the programme can last from 6 to 36 months. The Ministry of Education and Science signs contracts with successful project applicants. These contracts describe the research which has to be carried out, fix deadlines and plan the costs of the project as well as the rights and obligations of the Ministry and applicant. In order to ensure regular supervision of the implementation of projects, each stage is no longer than 6 months. At the beginning of each stage, 50% of the money is paid in advance. At the end of each stage, the contractor has to submit reports on the project content and its financial progress. At the end of the project a report on the whole project has to be submitted for the approval of the Ministry of Education and Science.

Despite the primary weakness of insufficient funding, the strengths seem to prevail. These are

- Programme objectives in compliance with the EU priorities;
- Orientation to SME needs;
- Possibility to submit project applications throughout the year;
- Easy application procedures;
- Big possibilities for applied research projects;
- Efficient funding.

The programme can be regarded as best practice because of the consistency of the programme's R&D objectives. *Short-term*: innovative new products & technologies that are market-oriented. *Medium-term:* rise in patents registered in Latvia, facilitating scientific research, development of the supported discipline of science, development of applied research of new technologies and products. *Long-term:* Knowledge transfer, increase in exports, facilitation of science/industry cooperation, increase in the competitive capacity of Latvian scientists, development of technologically oriented SMEs, improvement of quality assurance systems, creation of new work places in knowledge based sectors.

Austria

In the Austrian focus group the *Competence Centre Programme (COMET),* or rather its predecessor programmes Kplus and Kind/net, was mentioned as a good practice example.

The Austrian Competence Centre Programmes are internationally recognized as best practice examples (for example, in OECD comparisons of PPP programmes). They aim at structural changes in the interactions between industry and science (which were found to be very weak in the 90s and a major weakness of the Austrian innovation system) by publicly supporting the establishment of research joint ventures between universities, research institutes and enterprises. Evaluations and assessments of the centres are performed on a regular basis, covering qualitative (peer-review) and quantitative (measurement of additionality) evaluation approaches. The concurrent assessment of additionality shows substantial additionality, predominantly of the behavioural type (i.e. in strategically re-orienting the activities of the participants), but also output additionality, although to a lesser degree. Evaluations have also shown that the smallest centres have the highest innovation impact. Thus, the main effect of the Competence Centre Programmes was seen not in their contribution to raising innovation outputs directly, but rather in their effect on the structural change in the behaviour of participants.

Some programmes (or types of funding) were singled out as having a potentially high effect on innovation (in terms of innovation output). These were not the R&D programmes in the core focus of the ImpLore project as they were either (i) not a programme with finite duration, a mission and earmarked monies or (ii) programmes which partly covered R&D but were mainly oriented towards innovation activities (mostly of SMEs).

The first category is:

'General Programmes' of the Austrian Research Promotion Agency (FFG)

These are programmes which do not have a limited duration, a pre-defined target group or technology area and allocate monies for bottom-up funding of industrial research and innovation in enterprises. They account for approximately two-third of R&D funding by the agency and are distributed on the basis of the quality of projects (potential economic impact being one among a number of assessment criteria). This stream of funding is well monitored and regularly evaluated by external evaluators with respect to its economic impact. In recent evaluations, additionality has also been assessed. The positive outcomes in both dimensions support the assessment of the participants.

A second class of programmes was named that also had a considerable impact on innovation. It consists of the following:

COIN Programmes (Cooperation Innovation)

The group of COIN Programmes consist of small-scale programmes (for example, protecNETplus, AplusB, FHplus) that have clear objectives and a well-defined target group. *ProtecNETplus* supports SMEs in initiating innovation impulses by developing, testing and implementing technology transfer projects. *AplusB* promotes start-up companies that originate in the academic sector*. FHplus* targets competence building at Austrian Universities of Applied Sciences (FHs) in order to foster collaboration in R&D projects between the FHs and SMEs. The R&D content of the funded projects is questionable if existent at all, as the programmes are small-scale and primarily attract companies that occasionally perform R&D.

As a possible generalization, the view was brought forward that a type of programme which would 'tilt' occasional R&D performers to become permanent ones is likely to have a large impact on innovation as well.

There was a discussion about the 'scalability' of the COIN (or similar) programmes. There seemed to be a consensus that 'they were just about the right size', i.e. doubling their size would not double the innovation impact. They were therefore conceived as a type of programme which has a strong impact relative to its size, but not in absolute terms, because of the limited size and weight of the respective target groups.

Czech Republic: Technology Centres Programme

An interesting case of a programme that attracts investment in the innovative activities in the New Member States is the Technology Centres (TC) programme in the Czech Republic. The purpose of the programme of targeted investment incentives is to support both:

- The development of business R&D and ICT activities and
- The creation of related high-skill jobs in the Czech Republic.

The program aims particularly at supporting the investment that is

- directed to activities of high-value added in production chain
- generates innovation output with noticeable knowledge spillovers.

The programme was operational from 2004 until 2006. At present, a new version of the programme is being prepared. The programme is managed by Czechinvest (Investment and Business Development Agency) on behalf of the Ministry of Industry and Trade.

Technology Centres refer to centres focused on the development and innovation of high-tech products and technologies. Strong emphasis is being put on the potential of turning development activities into innovative products. The support is industry-specific, targeting mainly aerospace, office and computer equipment, electronics and microelectronics, telecommunications and pharmaceuticals, scientific instruments and specialised equipment, motor vehicles, industrial electrical machinery, production of chemical products, road transport equipment, engines, turbines and agricultural machinery.

Applicants for support can be both Czech and foreign legal entities, which means local or foreign entrepreneurial entities intending to implement a project in the Czech Republic. Recipients can only be Czech legal entities or subsidiaries of a foreign entity located in the Czech Republic. Forms of support comprise a subsidy for business activity and a subsidy for training and re-training.

The purpose of the subsidy for business activity is to cover certain operational costs related to the project, namely payroll costs, purchase of services, purchase of materials, goods and energy. The maximum level of the total subsidy for the whole project must not exceed a percentage (the percentage depends on the region and is set by the European Union) of either a five-year investment in assets, or two years' salaries for employees (only jobs created within the first three years can be subsidized). The purpose of the subsidy for training and re-training is to cover training and retraining expenses related to the project. Eligibility criteria include a minimum level of investment, a minimum number of jobs created and a minimum investment of self-financed resources.

There is a detailed evaluation scheme used to calculate the impact of the supported projects on job creation. The number of applications implies that the Czech Republic is gradually becoming the most sought-after place for establishing new technology centres. Czechinvest has registered more than 59 projects of technology centres that created almost 3,600 new jobs. The quantity of investment and the number of newly created jobs are not perceived as the main contribution of the program. Its main focus – creation of high-skill jobs and development of high value-added activities and their productive effectiveness – has, however, not yet been systematically evaluated (which is quite a common problem with public support). Only some individual cases have been presented at conferences and seminars with a rather positive reflection in the business and academic communities. Deeper analytical assessment of the program would be very desirable as it might show a diversity of applied investment strategies, both of domestic and foreign companies in R&D and training and their spillovers. Quite a positive systemic aspect of the program with a (potentially strong) favourable impact on innovation activities, can be seen in its dominant focus on technology and skill intensive activities directly linked to production, i.e. not to the R&D itself.

UK

A shortlist of 10 UK programmes that had been included in the ImpLore mapping database was used to facilitate discussions of the question: "which national programmes are believed to be most successful in terms of innovation impacts?" All the four applied industrial research programmes sponsored by the Department of Trade and Industry (superseded by the new Department for Innovation, Universities and Skills) were considered to have strong innovation objectives. These are designed for different purposes (for example, thematic, SME, science/industry collaboration) but innovation criteria dominate.

However, UK investment in industry-related R&D programmes is much lower than the amount that is invested in academic research through the seven *Research Councils*. The

Research Councils have traditionally been judged on performance indicators related to the quality of science but some work closer to the market than others. Also, the accumulated knowledge from many decades of development should lead to a much wider impact on the economy and society than the more focused industrial R&D programmes. More recently a second indicator (quality of exploitation), which is aimed at increasing the socio-economic impact of the investment in the UK science budget, has been introduced along with an obligation to produce annual economic impact reports.

Which Research Councils have the highest impact on innovation? The Medical Research Council (MRC) and the Engineering and Physical Sciences Research Council (EPSRC) must be the obvious candidates as they are closest to market. Another is the Biotechnology and Biological Sciences Research Council (BBSRC) which has a clear sector focus. One way of assessing this is to observe the amount of monetary inputs versus the impact outputs– i.e. looking at exploitation in a commercial sense. In this case the EPSRC and BBSRC should have the greatest impacts, followed by the MRC.

In comparison, the impacts of industrial R&D programmes were considered to be less strategic, partly due to their small size and partly because most of the impacts are unlikely to extend beyond the direct industrial participants.

USA: Advanced Technology Program

The Advanced Technology Program falls under the US Department of Commerce, National Institute of Standards and Technology (NIST). The objective of the ATP is to "accelerate the development of innovative technologies for broad national benefit through partnerships with the private sector". Specific ATP goals are to increase the US scientific and technical knowledge base, expand and accelerate development and commercialisation of generic technologies, promote collaborative R&D, refine manufacturing processes and increase the competitiveness of US firms. ATP was established by the Omnibus Trade and Competitiveness Act of 1988.

Description of main design features:

ATP is designed as a bridge between research and the marketplace. The programme offers cost-share funding of about $1 million per year per project. For-profit companies conceive of, propose, co-fund and execute ATP projects in partnership with other companies, academia, independent research organisations or federal labs. Joint ventures of two or more companies pay at least half of the project costs, large (Fortune 500) companies applying individually must pay at least 60 percent of project costs, and SMEs applying individually must pay a minimum of all indirect costs of a project. Research allocations by ATP are driven by bottom-up submissions from the private industry, based on their understanding of the marketplace and research opportunities. Selection criteria are equally weighted between scientific and technological merit (50%) and the potential for broad-based economic benefits (50%). Applications are processed through a multi-step peer-reviewed procedure: (1) scientific and technological merit pre-proposal offerings, (2) full business proposals that address the potential for broad-based economic impacts, (3) semi-finalists procedures that involve an oral review and (4) final selection and cooperative agreement. Rejected proposals receive a debriefing.

Since 1990, ATP has received over 6,900 project applications and made nearly 770 awards involving more than 1,500 participants. Nearly four-fifths of lead company awards have been made to SMEs. Of more than $4.3 billion of high-risk research funded, $2.3 billion has come from ATP share and $2.1 billion from industry. The leading technological fields of ATP funding have been electronics/photonics (25%), information technology (23%), advanced materials/chemistry (21%) and biotechnology (20%).

Federal support for the ATP has fluctuated significantly since its inception. In 1995, the ATP federal contribution peaked at $311 million. After this point, the budget declined, as control of Congress (1995) and the White House (1999) shifted to Republicans who were concerned that the ATP represented an unnecessary government subsidy to industry. In recent years, the administration has sought to zero out the ATP budget.

Evidence of impact on innovation:

Although in political debate, questions have been raised about the effectiveness of ATP, a series of agency and independent studies have confirmed that ATP has a positive impact on evaluation and is not a duplicative subsidy to industry. ATP's studies suggest that industry "would not have undertaken 40% of ATP projects and another 40% would have proceeded on a much slower scale" and that "ATP funding accelerates the R&D cycle for 9 out of 10 companies and over half are ahead by 1 to 3 years." The programme also reports high rates of collaboration: "Four out of five ATP projects involved collaborative relationships, ranging from R&D partnerships with other firms, universities, and non-profit labs, to alliances with other firms to pursue commercialization." Over 1,170 patents are associated with ATP projects and, overall, ATP estimates that it has generated more than $18 billion in expected present value social benefits – a return on federal investment of more than 8:1. The National Research Council also conducted an independent assessment that concluded that ATP effectively met its legislative goals.

Key design features of the ATP include a clear mission statement, incentives to encourage collaborative projects to accelerate research commercialisation, a bottom-up application procedure accompanied by expert peer review, the requirement on applicants to consider business and economic prospects as well as scientific and technical capabilities and ongoing evaluation of performance and outcomes. Good practise in programme design and operation has not allowed ATP to escape political debate about the appropriate role of government in subsidising research commercialisation, although it has allowed ATP to robustly document its performance. This has helped the programme to survive and may, in the near future, lead to a resumption of federal budgetary support.

Germany

It was suggested when focusing on direct industrial outcomes only, the 'Microsystems technology programme' and 'Research for the Production of Tomorrow' could be regarded as best-practice with respect to innovation impacts and the criteria of programmes of the ImpLore project.

Microsystems technology programme

The Microsystems framework programme provides targeted funding for areas in which a leverage effect can be achieved in terms of growth and employment and in which German research and industry can be strengthened in international competition. The concept is very open and flexible in its thematic priorities and is intended to keep up with the dynamic developments in technology and industry. Due to its integrating character, microsystems technology requires a high degree of interdisciplinary cooperation. Funding is therefore focused on collaborative projects which provide a framework for tapping the scientific potential of R&D institutions and establishing networks between companies. Besides project funding under the Microsystems framework programme, measures to support innovations are used for a targeted reduction of existing innovation barriers. They aim to create transparency in the concepts, processes and results of funding, take into account the international integration of the German microsystems technology, raise awareness of initial and continuing vocational training and initiate and promote dialogue between research and industry.

Research for the Production *of Tomorrow*

The Federal Ministry of Education and Research (BMBF) supports research on new production technologies with the objective of developing model solutions for future-oriented production in Germany and providing research results for broad use, in particular in small and medium-sized enterprises (SMEs). This should contribute to securing employment and prosperity in Germany and Europe. After all, the processing industry is one of the most important sectors in Germany with 8.1 million employees. The German manufacturing industry is in a leadership position with an export quota of about 37%. In the framework concept "Research for the Production of Tomorrow", which was designed as a "learning programme", research needs are taken up rapidly and directly, following talks with experts in enterprises and research institutions, associations and trade unions. The research topics are announced in calls for proposals. The best consortia from science and industry that emerge from these idea competitions are funded by the BMBF, to the tune of up to 50% of their costs. So far, the BMBF has funded over 170 collaborative projects with about 1,300 partners in different topics under the framework concept "Research for the Production of Tomorrow".

USA: Small Business Innovation Research programme

The Small Business Innovation Research (SBIR) programme is a US Federal Government (Multi-Agency) programme. SBIR was established in 1982 with the objective of increasing US small business capabilities to meet federal R&D requirements. The programme has also assumed a role in enhancing the technological competitiveness of small businesses by supporting entrepreneurial start-ups to commercialise technologies. Under the SBIR programme, federal agencies with extramural R&D budgets of $100 million or more reserve 2.5 percent of their R&D funding for SBIR applicants. Eleven federal agencies currently offer SBIR awards.

Description of main design features:

The SBIR programme provides support to small businesses as they develop and seek to commercialise their ideas. SBIR Phase I Awards provide up to $100,000 for approximately one year to support the exploration of the scientific, technical and commercial feasibility of an idea or technology. Phase II Awards provide funding of up to $750,000 for as long as two years to expand the results of Phase I. It is anticipated that technologies will then move into the marketplace in Phase III of the programme, although no direct financial support is provided for this phase. To apply for an SBIR award, eligible small businesses must be for-profit, US-owned, and independently operated. Awards are made by the individual agencies based on the small businesses' qualifications and the degree of innovation and future market potential of the proposed project.

Evidence of impact on innovation:

The Innovation Development Institute has monitored SBIR awards. From 1983 to 2006, the Institute reported $20.6 billion in total awards since 1983, 70,056 Phase I awards (cumulative), 24,910 Phase II awards (cumulative), 16,222 participating firms, 57,280 patents granted, 1,496 venture capital investments, leveraging $26.8 billion in venture capital, 597 publicly-traded companies, and 914 M&As (mergers and acquisitions). While these cumulative numbers are notable, other evaluations of SBIR have reported mixed results. A 1999 study by the US Government Accountability Office raised concerns about the effectiveness of SBIR's commercialisation goals and evaluation procedures. In 2003, the Office of Management and Budget, using its Programme Assessment Rating Tool (PART), found the Commerce Department's SBIR programme to be generally well-managed, but also raised issues about performance measures. Lerner (1999) found that Phase I SBIR awardees grew faster and were more likely to attract venture capital than similar non-awardees, although this effect was limited to those regions which already had venture capital and high-technology. A recent study by Toole and Czarnitzki (2007) finds that in the biomedical field there is increasing use of SBIR as a commercialisation pathway and that scientifically linked SBIR awardees completing Phase II increased their chances of subsequent venture capital investment. There is evidence that SBIR performs two important roles in the US innovation system. First, SBIR is a match for venture capital because it offers, for example,, an early funding stream and certification mechanism for fledgling entrepreneurs to develop innovative technologies, which subsequently can attract private funding. Second, SBIR may also serve as an alternate to venture capital, particularly in regions where venture capital is weak and where entrepreneurs are developing innovations but do not have the high growth potential required by venture capital. Although run in a decentralised manner, SBIR offers a consistent pathway to innovative SMEs to access stages of early funding.

Italy

The focus group participants basically agree that success and good practice experiences are not really related to single programmes, but rather to the development of the systemic approach to supporting R&D and innovation.

It is clear that the Italian R&D and innovation policies are carefully tailored towards the characteristics and needs of different players, of different R&D and innovation goals and of the regional territory and its economic, industrial and also social characteristics.

Success experience no. 1: Establishing Networks based on trust and the benefits of concrete collaboration.

The experience is presented by an institute that deals with the development of advanced processes for manufacturing, also involving the use of new materials. The key strategic and operational characteristics of this experience, which is still alive and ongoing, are

- establishment and building of relationships
- developing trust between players and working towards the mid- and long-term co-operative strategies
- developing mechanisms to support and ease the transfer of experience from north to south
- adopting a precise organisational structure approach through the establishment of research companies which have clear and measurable performance objectives, in economic and output terms
- working to attract researchers and putting in place mechanisms, such as participation, to involve them concretely in the company and its operations
- creating strong co-operative links with the SMEs from the region to integrate their innovation processes with the activities of the research company

- supporting the training of the researchers as well as the turnover in the company, establishing a culture of discussion, exchange and change
- deeply embedding the research company in the region but also supporting the development of global scale operations
- using public R&D and innovation funds only for the initial start-up phase and introducing a sustainability culture, so that the R&D company's operations can become independent.

Success experience no. 2: Integrating and disseminating knowledge

The experience is presented by the programme manager and head of institutional relationships of AVIO Spa, a former FIAT company spin-off and one of the key players in the aeronautical sector. The core elements of this experience are

- Putting in place enterprise innovation processes which develop and combine R&D and management skills
- Taking advantage of a strong orientation towards innovation to spread the innovation culture across the entire organisation, and not limiting it to specific portions
- The careful use of public R&D and innovation grants to create the foundations of sustainable R&D processes integrated in the production processes, but reliance on the market for further sustainability
- The continuous interaction with policy-makers in this field to assess approaches and to suggest practical improvements
- Building on the organisational integration of R&D using information management methods and technologies for the functional and organisational integration of activities and components of an enterprise to collaborate, share knowledge and create a critical mass. This process takes advantage of public R&D and innovation funds
- The development of an approach to R&D and innovation which is independent of any application sector and seeks to identify those technological elements in each sector or activity which can benefit from R&D and innovation to generate value-added. Even mature sectors such as textiles can benefit from the introduction of new manufacturing processes which can boost competitiveness
- Taking advantage of R&D and innovation grants to support the integrated development of scientific and management skills: the head of the laboratory in Brindisi was trained within the National Research Programme supported by the Ministry of University and Research in the early nineties.

Success experience no. 3: Anchoring R&D activities in the region and supporting interdisciplinary projects

The experience is presented by the head of the Institute for coastal marine environment, National Research Council in Sicily. R&D and innovation support have had a major impact on

- Disseminating and cementing an RTD and innovation culture in a region with major economic and social difficulties related to culture, background, enterprise development and infrastructure
- The dynamics and performance of activities building scientific knowledge in cooperation with enterprises and institutional players; building and maintaining a network for the purpose of science and innovation development
- The involvement of regional institutions. Significant advantages have resulted from this cooperation
- The concrete involvement of enterprises in scientific development and innovation processes and support for their access to R&D and also guiding them to use different instruments for different purposes. The aim is to adequately compensate the risk associated with R&D and innovation activities.
- The interdisciplinary character of activities.
- Providing support for enterprises faced with an important commitment. In some cases such businesses were ready to take the risk and ask for loans from banks to support research and innovation activities
- The possibility to develop extremely differentiated interdisciplinary R&D activities, which can lead to the development of a number of different technological concepts which can be applied. These range from the air traffic support instrumentation to concepts in the pharmaceutical and biotechnological areas
- Raising the level of knowledge of the participating bodies and institutions, creating direct and indirect impacts on the actors themselves as well as on the broader areas in which the operate.

Norway: FORNY

The Norwegian FORNY programme works through public research institutions, the Technology Transfer Offices (TTOs) of these institutions or commercialisation units such as incubators and science parks. These commercialisation units are companies specialised in supporting entrepreneurs spinning-off from public research into business. The FORNY programme involves the following activities: It focuses on the attitudes and behaviour of research communities in order to make the search for commercialisation opportunities an integrated and prioritised task. It helps research institutions establish professional systems and organisations for the commercialisation of R&D results. It supports researchers with research based business ideas. It encourages and contributes to an increased cooperation between research communities, entrepreneurs, investors, industry and commerce, and public authorities.

The programme offers the following kinds of funding: Funding of infrastructure activities, i.e. aiming to make researchers and research institutions focus on the commercial potential of research results, funding of commercialisation projects, funding of verification of technology, i.e. proof of concept, scholarships to researchers which enable them to focus on the commercialisation project instead of their regular work. In addition, FORNY offers bonuses for the successful completion of commercialisation projects. The FORNY funding can cover a maximum of 50% of the costs related to the various activities.

Evidence of impact on innovation:

The evaluation report (Bolkesjø and Vareide, 2004) listed the following results of the FORNY-programme: Each year about 300 new commercialisation ideas have been evaluated for the period 2000-2003 and 2004-2006. The goal of 50 commercialisations per year has not been reached in the years 2000-2004, but in 2005 it reached 47. The majority (63 %) of all commercialisations has resulted in new companies being set up and 37 % in license agreements. The employment resulting from hiring new employees as well as turnover has increased each year. About 1.5 Billion NOK have been invested in new companies, which equals five times the original FORNY-support. The main sources of investments are private shareholders with additional 20% self-funding. Public sources (not FORNY) account for altogether 20 %. Of all the developed products and services 77 % represent a new product or service on the market, of these 85 % are also new on the international market; 36 % of commercialisations are patented.

During the period 1995-2004 the FORNY programme has been involved in 125 license agreements and the establishment of 231 new firms. In 2005 there were about 15 license agreements and 32 new firms. The established firms generated a net value creation during the period 1995-2004 of EUR 40 Million (salary + company profit). The total income in 2005 from all the present firms was about 63.5 Million EUR. The total number of employees in the 160 companies was 524 in 2004 and in 2005 637 employees in 200 companies.

France

The *PREDIT* programme (a manager from this programme was present in the group) presents an original character because it is under the responsibility of the Ministry of Equipment and Transport, which is characterized by a greater stability than the Ministry of Research. Furthermore, this is an inter-ministry and interdisciplinary programme, financed by several Ministries: Research, Transport, Industry, Environment, Energy and OSEO-ANVAR. They pool their funds to achieve common objectives: to ensure sustainable mobility of people and goods, to increase transport systems security; to improve the environment and contribute to the reduction of greenhouse gases. The programme has been subject to regular evaluations. The evaluation of PREDIT did not really try to measure its impacts on innovation. Instead, it focused on dealing with the processes of programme implementation and the balance between the various themes. The participants agreed that inter-ministry programmes have better prospects, because they benefit from a permanent secretariat: this is the case for PREDIT and the competitiveness poles.

Competitiveness poles

With the world economy growing increasingly competitive, in 2004 France decided to include the key factors affecting competitiveness in its new industrial policy. The most significant of these factors is the capacity for innovation. For a given local area a competitiveness cluster is defined as:

- an association of companies, research centres and educational institutions,
- working in partnership (under a common development strategy),
- a generation of synergies while executing innovative projects in the interest of one or more given markets.

The aim of this policy is to encourage, then support, projects initiated by the economic and academic players in a given local area. There are four success factors for each competitiveness cluster:

- implementing a common economic development strategy that is consistent with the area's overall development strategy,
- creating extensive partnerships between players for specific projects,
- focusing on technologies for markets with high growth potential,
- achieving a sufficient critical mass to acquire and develop international visibility.

By building a network of players at the forefront of innovation, the end goals of the new policy are the creation of new wealth and jobs in local areas.

Canada: Networks of Centres of Excellence

The Networks of Centres of Excellence (NCE) were launched in 1989 and modelled on a successful provincial level programme, the Ontario Centre of Excellence (OCE) programme. NCE became a permanent programme of the Government of Canada in 1997. NCE cover the whole nation, are multidisciplinary in scope and multi-sector in nature. The annual budget is 53.1 million EUR.

The objective of the NCE programme is to "mobilize Canada's research talent in the academic, private and public sectors and apply it to the task of developing the economy and improving the quality of life of Canadians" .

Description of main design features:

NCE are partnerships between universities, industry and the government. These three entities form consortia or alliances that are jointly administered by Canada's three granting agencies: the Canadian Institutes for Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC). This is done in partnership with the industry in Canada. In the fiscal year 2005-2006, the budget of the NCE programme amounted to 53.1 million EUR. The funding is channelled to the NCE through the granting councils.

Networks can qualify for a maximum of two seven-year funding terms after which they are either disperse or continue by building on their successes. One good example of a successful organisation is the Institute of Robotics and Intelligent Systems (IRIS). The NCE programme is evaluated every 5 five years on criteria of knowledge and technology transfer, exchange and exploitation. Approximately a third of the researchers, and nearly 60% of partners, believed that their networks had significant and/or commercial results that were truly groundbreaking in nature.

Evidence of impact on innovation:

In 2005-2006, the NCE programme comprised 25 networks, five of which were new initiative networks unveiled in spring 2007. The areas of expert investigation ranged from advanced mathematics to climate change, from studying stem cells for keys to cures for managing forests to ensure their survival. In 2005-2006, 926 companies, 350 provincial and federal government departments and agencies, 64 hospitals, 202 universities and more than 628 other organisations from Canada and abroad were involved in the NCE programme. About 91% of network graduates are successful at finding jobs. In 2005-2006 the networks stimulated outside investments of more than 45 million € including more than 17 million € from private-sector companies.

More than 6,000 researchers and highly qualified personnel were involved in the NCE programme and activities in one year alone (2005-2006). Indicators of NCE programme knowledge transfer (fiscal year 2005-2006) include: 60 patents to NCE scientists, 3,958 peer reviews publications, 37 granted licenses and 3 spin-off companies. It is the partnership of fresh talent (for example, graduates and post-docs), experienced researchers and academics in the public sector and researchers and entrepreneurs in the private sector that make it successful. The NCE show how academics and entrepreneurs can be brought together for innovation and help bringing R&D to the market for economic and social gains.

The Netherlands

The answers and discussion that followed from the first question were very interesting because all the participants mentioned programmes or instruments that did not meet the ImpLore criteria by which we have defined research programmes. Most mentioned other research or innovation instruments, such as the WBSO (the tax-deduction facility for R&D expenditures), the Vouchers, and innovation credit and subsidy programmes managed by SenterNovem.

While discussing the definition of a programme, the attention shifted towards the recently adopted 'programmatic approach' in the Netherlands. In 2006 the Ministry of Economic Affairs in the Netherlands introduced a new type of policy instrument called the 'programmatic approach'. Three features of this programmatic approach are rather new to Dutch innovation policy:

- The programmatic approach focuses on specific themes (either technology domains or societal issues) and aims at creating international excellence in those themes.
- The process of selecting these national priority research themes (for example, making use of foresight, high level panels, bottom-up competition, involving companies and other stakeholders, etc.)
- The approach relies on a bottom-up process, in which consortia of stakeholders (public-private-partnerships) and particularly the business sector take the initiative to define the main portfolio or mix of instruments and the contents and parts of the programme. Not only are linkages between academia-industry stimulated but also between companies. Another trend is the increased involvement of public research institutes as stakeholders in the design of a certain programme.

Under the umbrella programme format of, for instance, the **I**nnovation **O**riented Research **P**rogramme (IOP), or Smartmix, there is a diversity of programmes. This is because within the top-down defined broader framework there is room for a bottom-up customization of design and management issues. Therefore, the IOP-Genomics programme has design and management features that differ from, for instance, the IOP-Photonic Devices.

Part of the programmatic approach is also the trend to absorb a mix of inter-related instruments within one programme. EOS is a good example of this trend. In EOS (Energy Research Subsidy) there are different modules under one programme structure. Modules address different phases of the innovation chain, ranging from research to market introduction. For example, there is a module for long term research and one for new research, but there are also modules closer to the market, such as the demonstration module or the 'unique opportunities' module. Each of these modules has a different format, matching the specificities of the phase in the innovation trajectory. Moreover, there is fine-tuning in the design and management within each of the 5 pre-defined energy research themes.

Another example of absorbing or merging different policy instruments into a programmatic package is the IOP-TTI arrangement, where a number of existing IOPs achieved the goal (and support) of becoming a Top Technological Institute (TTI) in 2005.

4.4.5 Characteristics of Good Practice Programmes

It should be clear from the empirical evidence presented above that it is very difficult to single out national good practice examples of R&D programmes from the discussions of the focus groups as generally applicable role models. Nevertheless it seems possible to distil some general observations and principles which might be helpful in the future for designing R&D programmes with a view to increase their innovation impact.

Identifying and targeting innovation impacts

While assessing the innovation impact of R&D programmes it has to be kept in mind that only a few programmes were considered that directly aim at an impact on innovation. Most of the programmes are designed for different purposes and targets. However, some room for improvement with respect to enhancing the innovation impact of the programmes was seen by a majority of stakeholders. At the same time there were warnings that while trying to increase the innovation impact the other (prime) targets of R&D programmes should not be eroded.

In the same vein, various stakeholders suggested using a wide definition of innovation output instead of merely focusing on direct product and process innovations. A suggestion quite often put forward was also not only to consider successful innovations as 'innovation impact' but to include the *innovative behaviour* and the impact of the programme on the various dimensions of this behaviour (for example, collaboration, change in the nature of projects etc.) as an appropriate measure for the impact of the programme. This seems to be very appropriate given the nature of the programmes which very often address R&D activities quite distant from direct applicability to markets.

Programme characteristics

R&D programmes which were seen as good practice primarily aim to increase *co-operation between science and industry*. While these programmes do not necessarily aim at the production of direct innovation output they can, if successfully implemented, increase the innovation capabilities of the participants substantially. An important success factor is the long-term commitment of programmes supporting science-industry collaborations. This prevents the short-term interests of industrial partners from dominating. Science partners benefit from this line-up as critical masses are reached and networking effects are sought. Mostly, these programmes are organised as Competence Centres (in Sweden and Austria), Research and Technology Parks (in Greece) or Competiveness Clusters (in France). They are well planned and monitored.

Thematic (i.e. technology specific) programmes were said to have a potentially higher impact on innovation output because of their focus and the involvement of industry (which is more intense in these dedicated programmes). But even in this type of programme, a new generation of programmes has come into being, focusing more on collaboration and networking (i.e. more on behavioural additionality) and less on direct outcomes in the form of concrete technological solutions, as was the case in earlier programmes. Thus it may well be that the perception of a higher innovation impact could be attributed to this new feature of R&D programmes.

Small programmes with well defined objectives and target groups (and quite often little R&D content) also appear to have high innovation impacts, but are not scalable, i.e. they should not be expected to show impacts beyond their narrow target group. The R&D programmes that are most likely to have a large impact on innovation are probably those that 'push firms over the edge of R&D', that is, to incite them to engage in R&D for the first time even on a small scale.

Design and management characteristics

With respect to additional design characteristics of an R&D programme, the participants suggested some measures which have been shown to have the potential to increase short-term innovation impacts of R&D programmes in some cases:

- *Marketing and commercial exploitation plans*, if these are already part of the programme design, they will positively affect the likelihood to launch innovative products or services from the project carried out in the respective programme.
- *Rules for technology transfer* (including IPR rules) should be laid down in advance.
- A *"translator function"* should exist, i.e. somebody who "translates" the perspectives of the different participants (for example, this function was often performed by industrial PhD students)

A prerequisite for a programme to be effective at all is that every programme design should include a *process of defining clear and specific objectives*. These should be transparent, realistic and should be simple so that they can be understood by programme applicants. 'Goal overload' of the programme should definitely be avoided: it is important not to pursue overly diverse targets. This can be read as a warning against including too many innovation oriented goals in R&D programmes.

Another aspect of programme management considered to be very important was the *flexibility* to change the specification of goals/targets in order to allow learning processes to improve the programmes during the period of operation of the programme. It was said that programmes have to be 'open' to a certain extent, since the framework conditions are changing frequently, sometimes making it necessary to adjust the targets.

A main prerequisite of the success of a programme is seen in funding of the projects to be regular and dependable as well as the programme management being easily accessible. Companies should be provided with a funding framework that allows strategic planning of R&D projects.

Also, it was seen as important to determine and to communicate objectives and indicators for selection and assessment of projects with great clarity in order to facilitate project proposals. This can be achieved by

- supporting applicants and beneficiaries with intensive monitoring/coaching where they can directly address their problems to the responsible programme manager (SMEs in particular are often overstrained by administrative efforts)
- offering a pre-screening of project proposals in order to help enterprises ascertain which funding programme best fits their needs
- providing a 'toolbox' of support instruments with simple, transparent rules for application procedures
- avoiding long waiting periods for the final decision to accept or reject individual projects

A *clear chain of responsibilities within the funding agency* is necessary and is seen as essential to make use of tacit knowledge provided by the programme managers.

Repeatedly, the need for "holistic programme portfolio management" was stressed as a means to increase the overall effectiveness of R&D and innovation programmes. Individual programmes address different stages of the R&D and innovation process, sometimes they overlap, sometimes they leaving gaps and sometimes provide conflicting incentives to R&D performers. Hence, it was felt that either combining these initiatives under one umbrella (for example, a programme with different sub-programmes or initiatives) could be a means to increase coherence between measures. In the same vein, a better involvement of all stakeholders at all stages - from the start of the programme design to acting on feedback and the recommendations of programme participants could contribute to programme coherence and thus increase their effectiveness.

Monitoring and Evaluation Approaches

Most of the programmes covered by the focus groups were evaluated; but only a few programmes were assessed for their innovation impacts. The existing evaluations have shown that almost each programme has had an impact on innovation to a greater or lesser extent – regardless of whether it directly aims at fastening innovation directly. An important criterion for success is the implementation of a well prepared monitoring plan including performance indicators to which the programme management is committed.

Monitoring and evaluation practices can partly contribute to raising the innovation impact of R&D programmes. Currently assessments (of innovation impacts) are not 'built-in' to the programmes. They should be made a responsibility for programme managers and project administrators alike. There are only a few evaluations available which explicitly assess "innovation impacts" and most are of a qualitative/semi-quantitative nature. In order to improve our understanding of innovation impacts of R&D programmes, assessments should be done more systematically, on a more standardised basis and involving a mix of qualitative and quantitative approaches. Evaluations today mostly have a 'single programme' focus. However, the assessment of the innovation impact of a programme should be done in a 'systemic perspective' (context of the programme in an overall programme portfolio).

General remarks on the scope and limits to achieve innovation impact from R&D programmes

While the quest for increasing the innovation impact of R&D programmes was certainly visible in the majority of countries that were surveyed, some caution was raised with respect to how far this could go without harming other and sometimes more prior targets of R&D programmes. Quite often programme managers, policy makers and experts observed the following trade-offs and tensions and balances which have to be struck (see Figure 27).

Figure 27: R&D programmes and innovation impact: trade-offs, tensions and balances

Trade-offs, tensions and balances to be struck		
Strive towards 'innovation impact'	↔	Goal over-load for R&D programmes
Innovation impact of R&D programmes	↔	Other programmes to foster innovation
Innovation built into selection criteria	↔	Erosion of other targets (quality of R&D project)
Continuity of programme/targets	↔	Flexibility in implementation

Source: ImpLore

This has turned out to be a sensitive task for all stakeholders and will also be a major challenge for the future design of R&D programmes.

5 SUMMARY AND CONCLUSIONS

The aim of this study was to identify ways of assessing and improving the innovation impact of public R&D programmes and initiatives in Europe (ImpLore). Particularly, the role of how a programme is designed, managed and evaluated for leveraging its innovation impacts was explored. By mapping R&D programmes, collecting the experience of programme managers and identifying good practices, the study intended to provide information and tips for policy makers to improve the link between public R&D funding and an economy's innovation performance.

R&D programmes and initiatives comprise all public activities intended to fund R&D activities performed in public or private organisations. Indirect public R&D support through tax incentives and similar instruments are not regarded as R&D programmes in this document. Innovation, in this report, refers to the successful introduction of new technology or new types of products and processes.

The findings are based on a multitude of empirical data and analysis:

- A database of all major R&D programmes at the national level in Europe and some third countries covering 431 individual programmes;
- A survey of 173 R&D programme managers across Europe, evaluation reports and reviews of R&D programmes;
- A set of 36 country reports, accompanied by a Delphi-type survey of country experts;
- An analysis of 47 evaluation reports on R&D programmes and initiatives from 17 different countries;
- A focus group approach involving policy makers, programme managers, industry representatives and policy analysts from ten different European countries;
- Input from a closely related study on innovation impacts of Community RTD Framework Programmes (InnoImpact) and from a High-level Advisory Panel.

This section summarises key findings of the ImpLore study and discusses likely policy conclusions for policy makers and programme managers who want to benchmark R&D programmes with respect to their potential innovation impacts and adjust design, management and evaluation features of programmes to achieve higher innovation outcomes of R&D projects funded through these programmes. One should be aware, however, that there are several limitations to such conclusions:

- First, R&D programmes are primarily designed and managed to enable or increase R&D activities. Innovation output may be a desired result but it is rarely a central goal. There are also many R&D programmes that are solely focused on supporting research without aiming at any innovation impact, particularly with regard to funding basic research activities. It is thus difficult to clearly associate certain design and management features of R&D programmes with (not directly intended) innovation impacts.

- Secondly, the innovation outcome of R&D efforts is affected by many variables. The characteristics of a public programme from which a given R&D activity has received a certain level of support are only of some, often rather limited significance. Attributing the relative contribution of R&D programmes to innovation success is thus anything but easy.

- Thirdly, R&D programmes are embedded in a national system of policy making as well as a national innovation system. Country size, the stage of development of both policy making and innovation, and a country's knowledge base are major driving forces for national differences in the design and management of R&D programmes, and hence for innovation impacts of these programmes.

Key Findings

The report analysed the design, management and evaluation features of R&D programmes and initiatives with respect to their likely impacts on spurring the innovation output of R&D activities funded through the programmes. A number of **design elements** proved to be relevant:

- A mapping of public **R&D programmes** across Europe revealed that programmes **differ considerably** in the way they tackle innovation challenges, ranging from purely research-driven programmes to those that directly link R&D support to the commercial exploitation of research results. Innovation-driven R&D programmes are typically characterised by explicitly addressing barriers to innovation such as lack of customer responsiveness, lack of financing later stages of new product development, or lack of qualified personnel and access to external knowledge. Not surprisingly, they tend to generate a higher innovation impact compared to programmes with a strong research rationale. Considering innovation barriers specific to the types of R&D activities funded under a certain R&D programme is thus an important design element to foster innovation output.

- Programmes with a **business orientation** (i.e. focussing on industrial research, knowledge-based industry or internationalisation) naturally tend to have a higher direct innovation impact. The same applies to programmes that demand collaboration among enterprises. Research-driven programmes, i.e. programmes that give the highest priority to research excellence and tackling barriers to R&D activities, can still exert significant positive innovation impact when focusing on science-industry collaborations. This holds true even if a programme funds fundamental research and addresses research cooperation barriers. **Direct collaboration** between public research and enterprises within a single R&D project tends to outperform other types of knowledge exchange between the two sectors. An important success factor is the long-term commitment of programmes that support science-industry linkages.

- The mapping of R&D programmes further showed that programmes either follow a **generic rationale** i.e. address issues of knowledge spillovers, lack of available funds or barriers to R&D co-operation- or focus on **thematic issues**, i.e. a certain field of technology. Thematic programmes often show a rather high innovation impact compared to generic R&D programmes. Small programmes with well defined objectives and target groups are also likely to have higher innovation impacts, though these are typically limited to a very small fraction of the economy.

- Demanding **private co-funding** at the project level is also highly relevant for innovation impact. This result is intuitive since industrial partners who put in their own money are more likely to strive for commercial exploitation.

- R&D programmes that include the mandatory **dissemination of project results** to potential users, that have a deliberate strategy to directly involve users into R&D processes or that address other barriers to commercialising R&D results (for example, in the field of approval, standardisation and certification) are also perceived as having a higher innovation impact compared to R&D programmes that do not consider exploitation issues.

Programme **management** is another important element to achieve higher innovation impact of R&D programmes:

- The **criteria** used **to select proposals** for funding clearly make a difference in terms of innovation results generated by R&D activities. Naturally, selection criteria that favour projects with a high innovation potential are most likely to generate high innovation impacts. However, selection rules focussing on scientific excellence are also thought to generate a higher (direct or indirect) innovation impact. While such projects tend to be more risky and typically require more time until a measurable innovation output occurs, they are more demanding in terms of the degree of novelty and are thus more likely to open up new paths of technological development. Quite naturally, selecting projects based on excellence in transferring R&D results into application and commercialisation also fosters a project's innovation impact.

- Involving **stakeholders** (for example, representatives from industry or science associations) and (potential) beneficiaries of R&D programmes helps to orient programme design and management towards the opportunities for research in a particular field or market. Consultation exercises and workshops are the most common ways of stakeholder involvement. Using strategic intelligence tools and techniques such as foresight studies in order to identify upcoming fields of research, technology and innovation is less commonly regarded as a useful approach.

- Learning from **monitoring and evaluations** to identify programme design features likely to lead to higher innovation impact is the most widely used strategy of programme managers for increasing innovation impact of their programmes. Programme managers report less room for learning from other programmes in terms of adjusting the management of programmes towards higher innovation impacts.

- Focusing programmes on those participants that showed a strong innovation record in the past is a strategy that is rarely applied by programme managers.

Monitoring and evaluating programmes can provide helpful insights into how public R&D support can be transferred into innovation output.

- Evaluations have a high but yet not fully exploited potential to inform policy makers and programme managers about strategies and barriers to improve innovation impact. While the majority of R&D programmes in Europe are evaluated, innovation impact assessment remains a side issue. Surveys of beneficiaries and an analysis of the programme monitoring data are frequently used evaluation methods. Indicators used in evaluations of R&D programmes focus on labour and financial inputs to R&D, outputs (for example, patent applications) and the compliance of individual projects with programme objectives. Only a few programmes have been evaluated with respect to their innovation impacts. Learning from evaluations to increase innovation impacts is impeded by a number of shortcomings, including unclear attribution of innovation impacts to programme activities, failure to identify project results fallacy and inadequate consideration of time lags between programme activities and likely innovation outcomes.

- Regular project monitoring is important to achieve some innovation impact. However, only a minority of R&D programme managers see a need for a comprehensive "innovation impact assessment". This reflects that a direct innovation impact is not the main target of most of the R&D programmes in Europe. Rather the role of R&D programmes is to build up capacities and capabilities that might induce innovations later or indirectly, and outside the control of R&D programme managers.
- When introducing or (re-)designing R&D programmes, observations and results from other programmes are regularly used by programme managers. International benchmarking is a common practice when (re-)designing R&D programmes though direct transfer of programme strategies and elements is rare as each programme has to fit into the specific institutional framework of R&D policy within a certain country and the specific challenges a national R&D and innovation system is facing. Today, R&D programmes in most European countries as well as in the United States and Japan share a number of design, management and evaluation features. Hence, programme managers face some quite similar problems, opening up the opportunity for mutual learning. The report identifies a selected number of good practices in evaluation studies and describes those cases in more detail.

While the design, management and evaluation features listed above do have some relevance for strengthening the commercial exploitation of R&D results there is **no simple check list** for how to improve an R&D programme's innovation impact, nor is there a simple way to learn from good practice in one country for policy practice in another. One reason for this is that the innovation effects of programmes tend to vary across countries. In the New Member States, innovation impacts often relate to innovation infrastructures (technology parks, incubators, technology transfer offices) that are established to provide R&D performing firms with an innovation-friendly environment and to foster commercialisation of research results from public science. The EU Structural Funds have played an important role for this policy priority. The design of many of these programmes benefited from international policy learning. In the old member states, particularly in those with a highly developed innovation system and a high level of R&D investment, many innovation impacts of R&D programmes emerge from programmes focusing on science-industry linkages.

Innovation impacts of R&D programmes also vary a lot with respect to the type of innovative capacities, activities and results that are addressed by a programme. Direct innovation impact in terms of market success with new products is only one result, which typically stays with the industrial participants of a programme. More indirectly, programmes also enlarge research capacities and the *potentials* to innovate in future, though the exact innovation impacts of this type of effect is hardly measurable. Associated with this are effects on the innovation behaviour of participants. This behavioural additionality refers to the participants' ability to interact and build networks, utilise science as a source of innovation, adapt innovation strategies and overcome technological "lock-ins" or change R&D and innovation management practices. Finally, R&D programmes can also affect innovation at other enterprises and organisations not participating in a particular R&D programmes, for example, by opening up new paths of technology development or by triggering follow-up innovations. These effects, however, are highly unclear and tend to materialise over a long-term time horizon.

Policy Conclusions

Policies that aim at increasing the innovation impact of R&D programmes should consider four areas of activity:

- The **design of R&D programmes** in terms of rationales, target groups, thematic priorities, types of R&D activities supported, types of funding instruments applied;
- The **management of R&D programmes** in terms of project selection, communication with (potential) beneficiaries, influencing the design of project features, and accompanying project progress;
- The layout of programme **monitoring and evaluations** and the procedures to **learn** from the findings of these activities;
- The capacities and challenges of the **innovation system** within which an R&D programme operates, including the degree of policy intelligence to accurately identify innovation system characteristics and how to respond to current and upcoming challenges.

As stated above, considering design, management and evaluation characteristics that have proved to foster innovative output in some programmes will not automatically result in higher innovation impact of any R&D programme to which they are applied. There are clear **limits to** the extent to which R&D programmes can be **oriented towards the production of direct innovation output**. On one hand, the primary task of R&D programmes is to overcome barriers to invest in R&D, resulting from knowledge spillovers, financial market failures to finance high-risk activities or technological uncertainty. On the other hand, innovation is first of all an entrepreneurial activity. Innovative ideas will be successful if they are positively evaluated by the market and the innovating enterprise is able to compete against innovative ideas of other companies. Entrepreneurial capabilities, including advanced marketing and sales strategies, are imperative for this. Since R&D programmes are not designed to develop or improve entrepreneurial attitudes of participants, their scope to directly affect innovation success of R&D activities remains very limited. Thus a main finding of this study is that there is no straightforward benchmarking of the likely innovation impacts of R&D programmes. Every programme operates within a specific context which determines its goals and strategies, the design and management features and any potential impact on innovation. One should also keep in mind that R&D programmes frequently pursue a variety of different goals, among which direct innovation outputs are – for the great majority of R&D programmes – not high-priority targets.

A further limitation is the **lack of clear evidence from evaluations** about the programme features that are more likely to positively affect innovation outcome. Evaluations suffer from a lack of attributing programme characteristics to innovation performance of participants and a lack of information on other relevant variables that affect an enterprise's innovation record, such as the role of competition, demand and an enterprise's innovation, organisation and marketing capabilities. Innovation impact assessment is further complicated by the fact that innovation effects of R&D may occur only some time after finishing that R&D project.

Having said this, the report generated some generic findings on how one could potentially increase the innovation impact of an R&D programme as a starting point for further, in-depth analyses that have to consider the specific programme environment. The following **design, management and evaluation characteristics** tend to indicate a programme that is rather capable of producing a higher innovation impact:

- Programmes that support **linkages among actors** tend to have higher innovation impacts, particularly when collaboration among enterprises is concerned. Linking actors facilitates knowledge flows and mutual learning, can help to re-direct R&D activities towards promising thematic areas or particular needs of potential users, and increases critical mass and diversity of the knowledge available to a certain R&D project. All these factors are likely to increase the productivity of R&D activities both in terms of generating useful results and shortening the time-to-market, and will tend to improve innovation success. Linking actors need not necessarily rest on formal cooperation. Involving users in the definition stage of R&D projects or involving relevant innovation partners through advisory boards are other alternatives. Links can also be established through market-based transactions, for example, purchasing of technology or assigning contract research.

- **Collaborative R&D programmes** involving both science and industry organisations often prove to be more effective in terms of innovation output, particularly for path-breaking innovations. One has to bear in mind, however, that these innovations are also very risky, and project failure is also frequent. Industry-science collaboration seems to be an especially promising approach for countries with a highly developed and diversified innovation system.

- **Thematic programmes** that support a specific technology are considered to have a relatively higher innovation impact than programmes that do not focus on a particular field of technology or sector. One may argue that programme managers are able to accumulate specialised knowledge about the capacities, needs and constraints of R&D actors in the very specific research, technology and market environment they are responsible for and can thus target their programmes more specifically to generating faster and greater innovation impacts. Similarly, **small programmes** with well-defined objectives and target groups were also reported to have a relatively higher innovation impact.

- R&D programmes should include **project monitoring** that registers project progress with respect to achieving R&D and innovation goals. Monitoring activities should involve low costs from the side of participants and could be linked to ongoing evaluation or accompanying programme analysis. Monitoring should serve as a feedback mechanism and be used to adjust programme design features.

- R&D programmes should be subject to **impact evaluations** that assess the contribution of programme activities to the innovation performance of beneficiaries. Since conducting such evaluations requires a certain amount of information on the funded projects and the programme participants, programmes should collect that information through application and monitoring procedures, to ensure that costs for participants should be as small as possible.

- R&D programmes should consider the results of monitoring and evaluation activities of other programmes, including the **experiences of other countries** when designing programme features. While learning from international experience can be helpful, a direct transfer of a programme that has proved successful in one country to another is rarely a wise strategy since programme success is depending on various environmental factors such as a programme's role within the R&D policy mix, the capacities of a national innovation system, global developments in relevant fields of technology and markets, etc. It is highly unlikely that these environmental factors will be similar in another country at the same time.

- R&D programmes that **involve stakeholders** through consultation processes or advisory panels tend to show a better performance in terms of innovation impacts. Stakeholders are most likely to be aware of upcoming trends and challenges to which a programme should response in order to maximise the innovation outcome of R&D efforts. Strong stakeholder involvement can have some shortcomings, however, particularly if stakeholder groups are not well balanced and pursue myopic and particularistic interests.

The **European Commission** can contribute to improving innovation impacts of public R&D programmes in Europe primarily in two ways:

- First, the Commission could make a significant step in **improving monitoring and evaluation practices** with respect to identifying innovation impacts of public R&D funding. Though many programme managers report innovation impacts for their programmes, monitoring and evaluations mostly account for these impacts only partly. Programme managers could profit from a kind of good practice summary on monitoring and evaluation activities that capture innovation impacts of R&D programmes. This report offers a number of generic findings that should be considered in this respect. The InnoImpact project can be taken as a useful starting point for a number of practical tips on how to design such monitoring and evaluation activities. For the Community RTD Framework Programmes, adequate methods for assessing innovation impacts should be applied regularly.

- Secondly, this study has shown that individual R&D programmes are often too small in scale and too narrowly designed to specific R&D barriers to impact innovation significantly. Establishing a set of R&D and innovation programmes that is designed, managed and monitored collectively regarding their effect on innovation would promise to improve R&D programmes' innovation impacts. The Commission could initiate ways to better interlink individual R&D programmes and to form **coherent sets of programmes** in critical areas which cover different moments of the innovation cycle. The Commission can work with country member governments to ensure the existence of a whole suite of programmes which companies access to bring a technology to fruition. Some of these programmes may be offered at the EU level, others at the member state level, others at the regional level.

- Thirdly, learning among R&D programme managers is crucial. Since most of the experiences of the programme managers is context specific and not easy to transfer to other environments, personal communication and exchange among programme managers and policy makers is needed. The Commission could maintain and further develop **networking among R&D programme managers**. EU initiatives such as ERAnets, TAFTIE and TrendChart already provide platforms for exchanging experiences and for meeting each other on a flexible base. These activities could be used to specifically take up the issue of innovation impacts from R&D programmes. Regular thematic workshops, sharing evaluation methodologies and results and exchange of good practice should be part of such activities. A particular focus could be laid on linking policy makers from the R&D policy domain and the innovation policy domain to better share experiences on how to trigger innovation results through R&D funding.

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A APPENDIX 1: METHODOLOGY PAPER

A.1 Introduction and overview

The aim of this short paper is to describe and clarify the methodology of the ImpLore project. The overall aims of the ImpLore project are to explore ways of improving the innovation impact of R&D programmes; to draw lessons for the design and management of such programmes; and to disseminate the results of the project. Fulfilling these objectives involves:

- The development of an appropriate methodology;
- The collection and mapping of data on R&D programmes and innovation impacts and the strategies involved in designing and managing R&D programmes and assessing and enhancing impacts;
- The analysis of these data via the benchmarking of R&D programmes and the identification of good practice;
- The organisation of an international conference.

The remainder of this introduction gives a brief outline of the main methodological elements involved in the steps above, except for the conference.

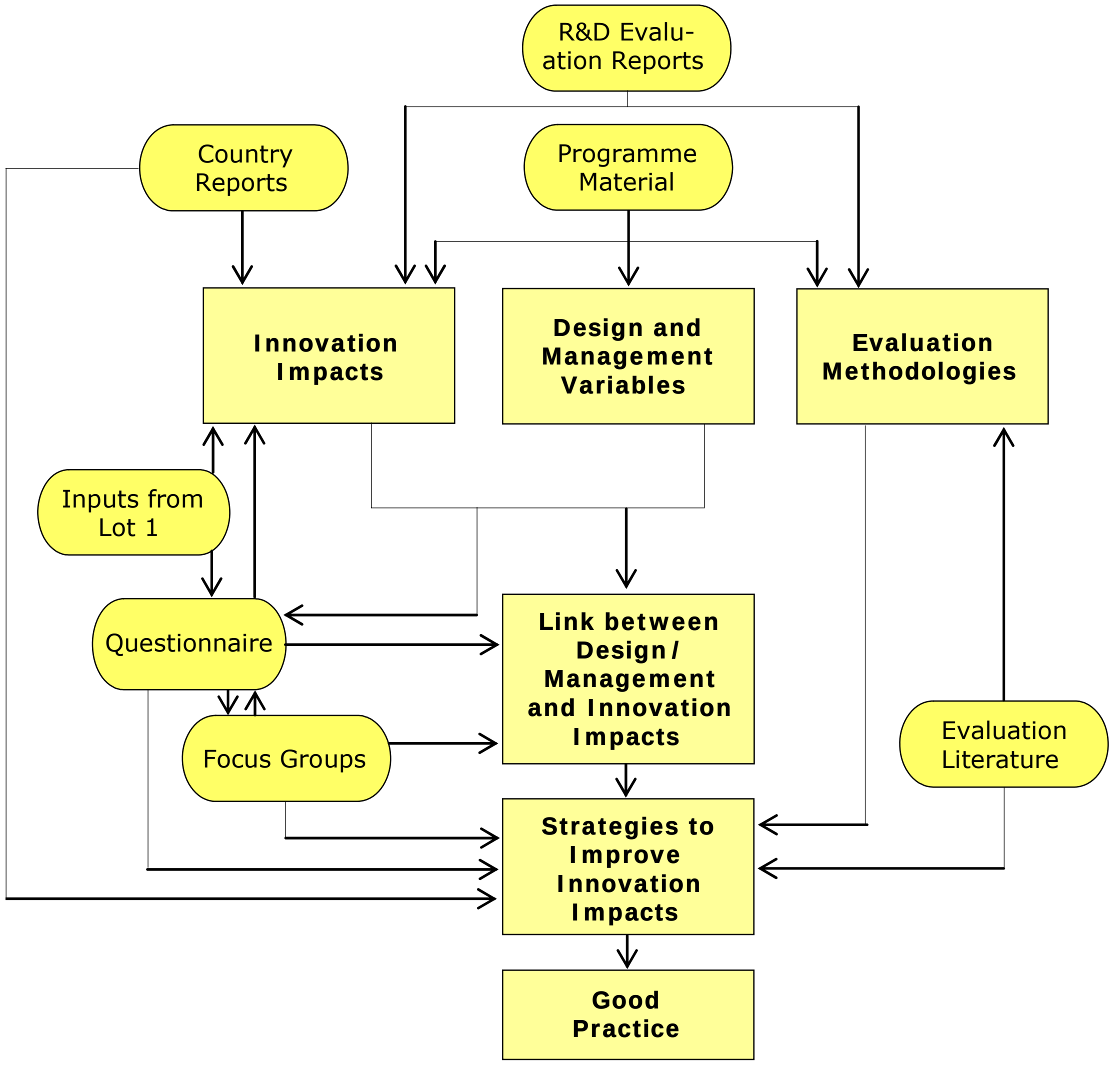
Several methodological problems occurred in earlier phases. Some issues had already been solved some time ago. In this paper we explain how the methodology has been improved and which additional efforts are proposed to solve the remaining issues. One problem we faced concerns the programme level of analysis. R&D programmes that were included in the database have a limited duration, a well-defined budget, a pre-defined target group, and pre-defined target activities. Programmes included in the analysis are only R&D programmes on the federal level and were completed within the last five years. The main focus is on programmes that foster predominantly R&D. Thus, following our definition, it was not possible to cover all public funded research activities and initiatives in the database. This implies that some R&D programmes, cluster-, regional-, or mixed/integrated programmes or related initiatives did not enter the database, e.g. the Industrial Districts programme in Italy or the Objective 2 programmes in France. This method also implies that the (non-programmed) research and evaluation activities at the level of institutions is not included in the database, (e.g. the Dutch Technological Institutes, on the other hand the 28 Swedish Competence centres are included as a programme). Another problem concerning programme as the unit of analysis is the existence of Super-programmes, with sub-programme where we decided not to enter all the sub-programmes. Several of these problems were addressed by the development of country reports, where the wider public R&D policy context is discussed and the selection of programmes is explained. One of the remaining challenges was to find a better methodology to analyse the innovation impacts and the linkage with the programme characteristics. To solve this issue a survey forms a new element in the ImpLore methodology.

The methodology paper addresses issues related to data collection and explanations with regard to the analysis.

Overview of the Relationships Between Data Collection and Analysis Elements

The main relationships between the data collection elements of the study and the analytical elements into which they feed are shown in Figure 28.

Figure 28: Overview of the methodological approach



Source: ImpLore

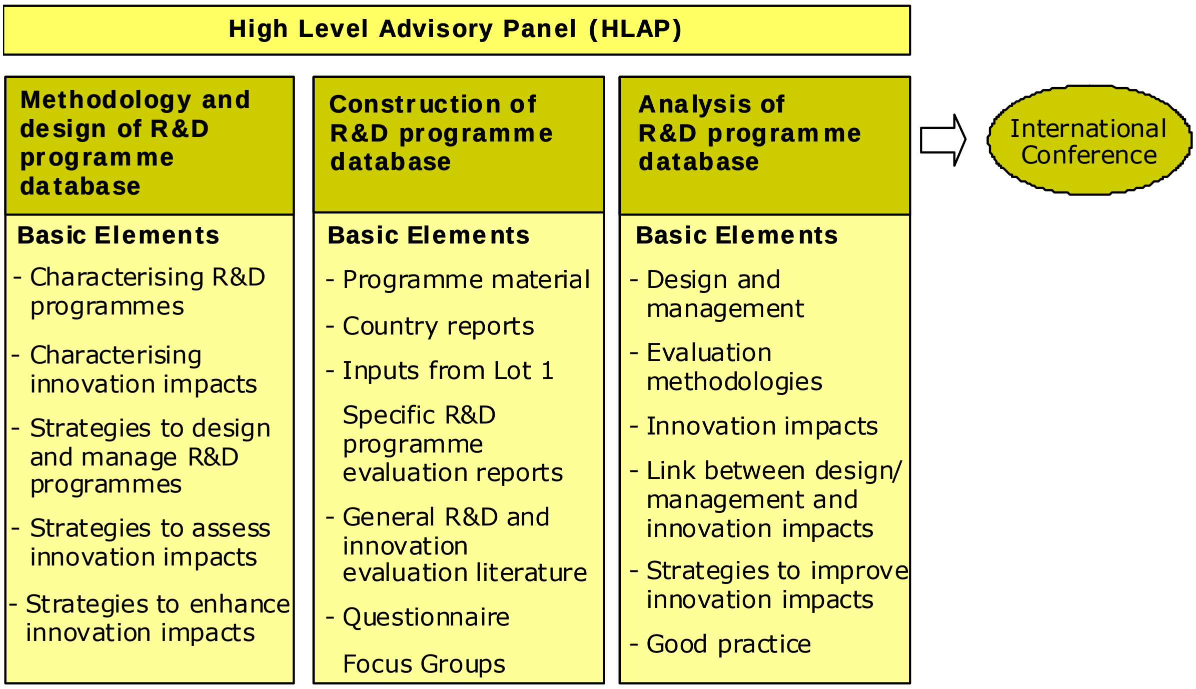
The boxes and arrows shaded red show how the main analytical elements are linked, with the analyses of innovation impacts and design and management variables combining to produce a better understanding of the relationship between the design and management of programmes and their associated innovation impacts. In turn, when combined with analyses of evaluation methodologies, this leads in the first instance to a better understanding of strategies to improve innovation impacts, and secondly to the identification of examples of good practice in this sphere.

The unshaded boxes and arrows show how the data collection elements feed into the analytical elements. The general flow is from the data collection elements to the analytical elements, but there are also flows in the opposite direction via the generation of hypotheses in the early analytical stages that influence the design of later data collection elements (e.g. the questionnaire and focus group elements). In turn, the results of these exercises feed into the later analytical elements (e.g. the element concerned with analysing the link between the design and management aspects of R&D programmes and innovation impacts). Some data collection elements also influence, complement and feed into other data collection elements.

Overview of the Overall Structure of the Project

In terms of the sequencing of activities and their relationship with the resulting international conference, the overall structure of the project can be depicted by Figure 29:

Figure 29: Overview of the proposed structure of the project



Source: ImpLore.

A.2 Data collection

One of the main objectives of the ImpLore study is to identify and list all initiatives and research programmes with significant impact on innovation. In order to facilitate this process, we have designed a database capable of characterising the nature and variety of:

- R&D programmes;
- Innovation impacts of R&D programmes;
- The strategies involved in enhancing the innovation impact of R&D programmes;
- The methodologies used to assess the scale of innovation impacts;

There are different levels of strategies or policies to increase innovation with publicly funded research and different levels of impact on innovation performance. For each combination there are different possible evaluation methodologies. Table 28 explains the positions of Lot 1 and Lot 2. Here, strategies could be defined as public policies to enhance innovation, and there are several levels. Methodologies is the term to reserve for the methods to measure, evaluate, monitor, assess, benchmark, analyze the success of strategies/policies. The compendium of methodologies will serve to explain the evaluation methodologies at the different levels.

Table 28: Level of research policy intervention and impact

	STRATEGIES *Level of research policy intervention*			
IMPACT *Level of research and innovation performance*	*R&D project or initiative, e.g. FP projects*	*Policy programme e.g. National Research programmes*	*Other policies from councils, agencies or Ministries, or EU*	*National Strategy*
Individual Researcher	**LOT 1**	e.g. Evaluations of personal grant programmes	e.g. Evaluation of researcher mobility or gender programme	e.g. International benchmarking of policy to promote mobility of researchers
Research project/group	**LOT 1**			
Research institute or company	**LOT 1** Survey	**LOT 2** Database, survey, Focus Group	**LOT 2** Country report, Focus group	**LOT 2** Country report, Focus group
National System of Innovation		**LOT 2** Country report, Focus group	**LOT 2** Country report, Focus group	**LOT 2** Country report, Focus group

Source: ImpLore

For individual R&D programmes, the database includes data on:

- A wide range of variables describing the design and management of R&D programmes (including elements relating to their strategic objectives and the 'openness' of programmes);
- Variables describing the evaluation and impact assessment, and the methodologies associated with individual programmes;
- Variables describing the innovation impacts associated with individual programmes;

The list of design features that describes the variables included in the database was developed in close collaboration with all consortium members. It was revised after a number of tests and discussions. The database covers more than 400 R&D programmes in the EU and a selected number of R&D programmes in third countries. It includes most relevant public R&D programmes that have an impact on innovation. R&D programmes that are included in the database are defined by the following characteristics: They have a limited duration, a well-defined budget, a pre-defined target group, and pre-defined target activities. This means that block grants to universities, permanent institutional subsidies, general R&D subsidies, and Structural Funds and other regional programmes are not included. The focus is on R&D programmes and initiatives on the federal level that foster predominantly R&D. In the country reports information on these other relevant strategies to increase innovation is provided. The study mostly comprises current R&D programmes, but also included some programmes that were completed within the last five years.

The data collection involved in the compilation of the database includes programme material, country reports, inputs from Lot 1, specific R&D programme evaluation reports, general R&D and innovation evaluation literature, a questionnaire addressed to programme managers, and focus groups. The different types of data collection are described in turn.

A.2.1 Programme material and evaluation studies

On the level of ministries and programme owners/programme management agencies, there is public information available about the rules and regulations governing the R&D programmes. Nevertheless, a considerable amount of original data has to be collected by different methods since not all kinds of information is publicly available. Additional data collection methods applied in order to fill gaps in the database were personal interviews and telephone interviews with programme managers. An online database was developed that enables the consortium members to type data about R&D programmes directly into database. Already existing publicly-available information was complemented by original data collected through a questionnaire addressed to programme managers. Different data collection methods were applied. An important input in the ImpLore project was the compendium of methodologies. The compendium of methodologies was basically the result of a literature review. In the first general part it is a description of methodologies applied in order to evaluate R&D programmes, including different kinds of impacts. It contains a description of qualitative and quantitative evaluation methodologies. The particular methodologies included in the compendium are qualitative interviews, case studies, surveys, control-group approaches, econometric modelling, and analysis of monitoring data. The focus is on evaluation of impact on innovation, and on methodologies which can be applied at the programme level of policy intervention.

A.2.2 Country reports

The aim of the country reports was to gather information and develop hypotheses on wider factors that influence the design, management and evaluation of the programmes in that country. These were then used as informal documents to inform a number of subsequent stages of the research. In the first section, the country report summarises the national characteristics and trends that have an impact on R&D programme innovation. This involves an investigation of characteristic programme design, management and evaluation features which experts believe have an impact on innovation, the barriers to impact and the impact enablers. The latter are the design features, tools and methodologies which are seen by experts to have a significant impact on innovation. In the second section, existing national innovation performance data is used as a tool to investigate the policy and programme drivers behind innovation performance. This allows us to gain expert opinions on which policies have had a significant impact and, by comparing innovation performance between countries, enables us to see why some countries are performing well and others poorly, particularly where the inputs are similar. The country reports helped to identify good practice examples.

Combined, this country data connects national innovation performance to innovation policy & programmes; provides hypotheses on high impact areas which can be tested with national experts and in the focus groups; highlights areas where international cooperation may be possible; and identifies areas of good practice and potential case studies. The 34 existing country reports were developed for internal purpose, but inform the quantitative analyses since they provide rich qualitative information that eases the interpretation of quantitative results.

A.2.3 Inputs from Lot 1

Lot 1 (InnoImpact) and Lot 2 (ImpLore) are set out to complement each other in terms of methodology and results. They chose different angles and units of analysis to address the question of how to assess and increase the impact of R&D programmes on innovation. While Lot 1 analyses - and in effect assesses - in great detail the innovation performance of R&D projects carried out in the context of a specific type of programmes (namely the collaborative R&D fostered by the EU's FPs), the task of Lot 2 is to broaden the scope to the comparison of programmes.

Thus, the two Lots necessarily differ with respect to analytical focus and methodological approach. In fact, Lot 1 has more depth but a more narrow focus, while Lot 2 must broaden the scope of analysis but cannot replicate the in-depth analysis on the project level carried out in Lot 1.

The results of Lot 1 feed into the work of Lot 2 in the following ways:

- Lot 1 has synthesized the current state-of-the-art in the analysis of R&D collaborations and the public means to foster such collaboration. It is drawing together also impact assessments of previous framework programmes, which – together with the current analysis using econometric approaches, survey and case studies – will provide a picture about the scope and the limits of fostering innovation through pre-competitive collaborative R&D programmes (it has to be remembered that a substantial part of R&D programmes are of that sort). Lot 2 used this work in its assessment of collaborative R&D programmes as one type of R&D programmes. Here, Lot 2 used the results of Lot 1.
- Lot 1 has developed – for the purpose of its own analysis – a taxonomy of indicators to use for appraisal of innovation impact. Again, these indicators concern predominantly the analysis of projects, but also the characterization of the EU FP as

collaborative R&D programmes, CORDIS being the main data source for this characterisation. Most of these data are qualitative in nature (e.g. selection criteria, IPR rules, existence of control/reporting system etc.). While some of these characteristics are unique to collaborative R&D programmes, others can be used to describe R&D programmes in general. Almost all of these indicators have been covered in the characterisation of programmes Lot 2 is carrying out. Here, Lot 2 used the conceptual inputs from Lot 1.

- The analysis of the impacts of the FPs (previous and current in Lot 1) served as a blueprint for analysis of the innovation impacts in R&D programmes of different nature. Insofar the type of analysis, the type of indicators to be applied and data to be collected in the assessment of the FPs can be a benchmark for other programmes. The underlying hypothesis here is that programmes with such tools of analysis in place will also be better able to foster innovation output. Here, results from Lot 1 can provide a showcase combination of analytical techniques to appraise programmes supporting collaborative R&D regarding their impact on innovation. Thus, the results derived from Lot 1 inform the interpretation of findings in Lot 2.

A.2.4 Specific R&D programme evaluation reports

It is clear from the programme mapping, and our wider experience, that there is considerable variation in evaluation policy and practice in Europe. In many cases the evaluation is simply limited to the evaluation of programme efficiency (organisational aspects). However, there are a minority of the programmes that have a formal system to evaluate effectiveness (achievement of objectives and impacts) and publish the results of such evaluations. One such programme is 'Knowledge Transfer Partnerships' in the UK, which publishes an annual report. This includes metrics and trend data on direct innovation outcomes such as increased jobs, profit and capital investment within the companies that receive support. Measuring direct innovation outcomes from an applied programme in which innovation criteria dominates is relatively straightforward. It is much more difficult to design evaluation methodologies to measure and attribute innovation impact for programmes that have wider objectives, such as those for basic research or general technology development.

We therefore shortlisted a number of national programmes of various types and in various countries that have published evaluation reports that include attributable impacts on innovation. We used these to carry out both quantitative and qualitative analysis as follows:

- A tabular analysis of innovation indicators that are used in these programmes in comparison with those used in Lot 1
- A tabular analysis of design and management factors that appear to be important to the innovation impacts that have been achieved
- Qualitative case studies of 10 contrasting programmes that offer transferable lessons for others in Europe

A.2.5 General R&D and innovation evaluation literature

One of the main deliverables of Lot 2 is a compendium of methodologies used to assess the innovation impacts of R&D programmes. This contains material gleaned not only from specific programme evaluation reports (see previous section) but also from the extensive literature that has accumulated in recent years on the evaluation of R&D programmes. This includes a number of comprehensive reviews of evaluation approaches and their utility. Many of these contain sections that focus on the assessment of impacts per se (e.g. impact on R&D spending of companies). The aim in this exercise, however, is to narrow the focus to those elements of the general literature dealing with the assessment of the innovation impacts of R&D programmes.

A.2.6 Survey

The strategy adopted in Lot 1 involves a self-assessment questionnaire targeted at participants in the EU RTD Fifth Framework Programme (FP5). In Lot 2, which is concerned with the innovation impacts of national rather than EU R&D programmes, the option of targeting participants in multiple national programmes is not feasible, largely on the grounds of cost, scale and availability of participation data (and also the ability to derive data for non-participants). It is feasible, however, to target the programme managers of multiple programmes in order to gain an overview of their assessments of innovation impacts and the factors affecting these impacts.

A questionnaire was sent, therefore, to the responsible managers of all programmes in the database for which there is relevant and adequate data on design and management variables. The questionnaire comprised three components. The first focuses on the innovation impacts of individual programmes. It exploist the innovation impact categories utilised in Lot 1 (themselves largely based upon work conducted over the past twenty years by some of the members of the Lot 2 consortium) and explores the range and scale of these impacts. The results of this section of the questionnaire was correlated with the information in the database on design and management variables. The second component of the questionnaire tackles the relationship between design and management variables from a different angle. In addition to empirical correlations between innovation impacts and design and management variables, this part of the questionnaire focuses on programme managers' perceptions of specific relationships between selected design and management variables and different types of impacts. In essence, the questions in this section test hypotheses derived from initial inspection of the data contained in the database and material contained in the general literature on the impact of R&D programmes on innovation. The final component of the questionnaire asks specific questions about the strategies adopted by individual programme managers or administrations to both assess and improve innovation impacts. These include both strategies deployed during the course of individual programmes and the strategies used by administrations to select and design programmes with the potential to have high innovation targets.

A.2.7 Focus groups

As analysis carried out so far has demonstrated, there are only a few evaluations of R&D programmes available at the moment, which also look into the assessment of innovation impacts. In addition, the methods and the indicators used are hardly comparable across a wide range of available assessments. Lot 2 copes with this lack of data in two ways: Firstly, by collecting quantitative data on impacts by means of a self-assessment questionnaire, secondly, Lot 2 engages in a series of focus groups to complement the quantitative data with qualitative assessments.

The method of focus groups which is a well established method in the social sciences was chosen (a) to be able to cover a relatively large number of interviewees, (b) to get different perspectives on individual programmes and not having to rely on probably too biased views of single interviewees. Target groups were programme managers, analysts and policy makers concerned with the most important (or most interesting) programmes in the respective country. They focus primarily on the perception of the innovation impacts by the interviewees, the relationship between design and management characteristics of the respective programmes and whether there is a discernable relation between these and innovation impacts as well as on the strategies (including assessment and evaluation practices) used to enhance these impacts. Focus groups were conducted in Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Poland, Sweden and the United Kingdom. Two focus groups each were conducted in Austria, Germany and Greece.

A.3 Data analysis, benchmarking and best practice

The notion of 'Benchmarking' refers to systematic, organised comparisons mostly but not exclusively of a quantitative nature. It is applied to a range of subjects, such as outputs or processes. Recently, the notion of 'intelligent benchmarking' has been coined (e.g., by Lundvall 1998) to distinguish between purely indicator-oriented benchmarking with little or no attention to the varieties and contexts from structured comparisons using both quantitative and qualitative measures to explain performance taking into account different contexts. In a comparison of national and international R&D programmes addressing different problems in their respective innovations systems and having different goals and objectives (among which innovation impact is just one), naturally, the approach employed in Lot 2 can only be that of 'intelligent benchmarking'. The bits and pieces of such an 'intelligent benchmarking' in the form of structured comparison using different sources of quantitative and qualitative information are presented below:

A.3.1 Design and management features and evaluation strategies

The database covers a large number of data about design and management characteristics of R&D programmes. It also contains information on types of evaluation and assessments performed. Quantitative analyses were conducted in order to compare and classify the R&D programmes in Europe. Descriptive statistical analyses were employed to surface differences with regard to design and management features of R&D programmes. In a second step, these design and management features were examined vis a vis the stated objectives of the programmes. Different programme objectives influence the choice of design modalities and the management of R&D programmes. Cross-tabulations of programme characteristics with programme objectives can provide interesting findings in this respect, as expected objectives often (but not always) represent a useful (albeit incomplete) surrogate for actual impacts of R&D programmes. The final step was the exploration of the effects of design and management features of the R&D programmes on their "actual" impacts (as assessed subjectively by programme managers – see below). There exist two general classes of possible impacts stemming from a programme: a) what might be termed the "general indirect effects on the capacity to innovate" (i.e., strengthening internal knowledge, networking of participating organisations, etc); and b) direct impacts (new products, new processes).

As mentioned earlier, given the impracticality of collecting relevant data (on direct and indirect impacts) from firms participating in these national R&D programmes, we utilized "perceptual" data given in Likert-type scales from programme managers (through the questionnaire described earlier). These are inherently subjective measures with well-known limitations. On the other hand these assessments may also over come the limited ability of traditional indicators to fully reflect impacts especially with regard to the usual timeline of program evaluations.

A.3.2 Evaluation methodologies

Government intervention for funding R&D has been justified by economists on the basis of market failures – due to positive external effects (spillovers) and uncertainties - and/or system failures – due to the complexities associated with scientific and technological advancements. ImpLore's compendium of methodologies points at the extensive toolkit of methods to evaluate R&D programmes, including both quantitative approaches such as econometric and statistical analysis, sociometric and social network analysis, bibliometrics, and qualitative methods such as logic models, descriptive case studies, historical tracing and expert judgment. These techniques may be used singly or in combination (mixed methods); may entail collection of primary data or use of secondary data; and may be directed at one or more of the outputs, outcomes, and impacts associated with a programme's objectives. The context and objectives for which the R&D programme evaluation is being conducted will shape the relative emphasis on quantitative and qualitative methodologies.

The practice of using formal evaluation as a tool to improve the design, management, and efficiency / effectiveness of public R&D programmes is relatively new. It is also very uneven between the EU member states. ImpLore partners have undertaken a comprehensive search to identify, characterize, and classify efforts of national/regional authorities to evaluate public R&D programmes, emphasizing ex-post appraisals of the innovation impact of those programmes in their respective countries as well as monitoring exercises during the life-time of the programme (questions H of the list of design features). For programmes that have had been evaluated the relevant information collected is informed by the analytical work in Lot 1.

The result of this search was utilized in two ways. On the one hand, it was incorporated into a compendium of methodologies. On the other hand, the resulting information pool was analyzed to draw a linkage between the use of formal evaluation techniques and improved R&D programme design, management, and implementation with respect to innovation impacts.

Two levels of analysis were conducted:

- First, a straightforward qualitative exercise to benchmark R&D programmes across Europe in terms of their evaluation and impact assessment strategies;
- Second, a quantitative benchmarking exercise to correlate programme evaluation features or lack thereof (questions H of the list of design features) to:

1.1 programme design and management characteristics and

1.2 the subjective perceptions of programme effectiveness in terms of innovation impact.

A.3.3 Strategies to improve innovation impacts

The analyses of design and management variables, innovation impacts and the relationships between them fed directly into an appraisal of the different ways in which programme managers implement strategies designed to improve innovation impacts. Empirically observed correlations between certain design or management elements and particular types of impacts, for example, can inform the design of future initiatives.

Evidence feeding from the compendium of evaluation strategies and directly from the questionnaire, focus groups and the review of the general R&D and innovation literature fed into an appraisal of the ways in which various 'strategic intelligence' approaches can help identify areas in which R&D initiatives might yield high innovation impacts. The aim of this module, therefore, was to enumerate and describe the various ways in which the innovation impacts of R&D programmes can be improved.

A.3.4 Good practice

As the notion of "intelligent benchmarking' implies, 'good practice' with respect to the improvement of design and management of R&D programmes with a view to increase their innovation impact can only be a 'contextual good practice'. Nevertheless, Lot 2 strived at the identification of patterns and commonalities between programmes and their characteristics, building on the results from the blocks on analysis described above. The goal was to produce a list of 'good practice examples' from a number of different contexts and covering different types of R&D programmes (collaborative R&D programmes like the FPs, programmes with focus on different types of R&D, etc.) which can act as showcase examples to guide policy makers and programme managers in programme management and design.

B APPENDIX 2: COMPENDIUM OF METHODOLOGIES

B.1 Evaluation and benchmarking

This compendium of evaluation methodologies briefly summarizes important background issues affecting the ImpLore analysis. The compendium of methodologies is the result of a literature review. It is basically a description of methodologies applied in order to evaluate R&D programmes. It contains a description of qualitative and quantitative evaluation methodologies. The specific methodologies included in the compendium are qualitative interviews, case studies, surveys, control-group approaches and econometric modelling. The focus is on evaluation of impact on innovation, and the methodologies which can be applied to the programme level of policy intervention.

It has to be mentioned that there are huge volumes written on numerous methodologies which can be used to evaluate publicly-funded research and the number and scope of methodologies is increasing. In order to build on the existing knowledge base we summarise the state of the art and some recent trends in this compendium of methodologies.

B.1.1 Different aims, object and unit of analysis, what is evaluated and why

Something which is often not made clear in the literature is the distinction between different objects of evaluation. However, there is a difference between evaluating research and evaluating research policy. Differences in the unit of analysis and the object of the evaluation call for different evaluation methodologies. This is also one of the major conclusions of the recent OECD working groups on "Evaluation of public funded research; recent trends and perspectives" (Georghiou et al. 2006). Furthermore, there are differences depending on whether the project or programme level of R&D programmes is evaluated. Some evaluation approaches, for example, analysis of quantitative impacts are feasible on the project level whereas their informational value is much more limited on the programme level. With respect to the ImpLore study it has to be highlighted that a number of R&D programmes covered by the study have a rather broad focus. This limits the usefulness of the simple aggregation of project impacts.

Bozeman and Gaughan (2000), for instance, focus on the level of individual researchers in their evaluation of research careers, based on data from CVs. This is clearly different from an evaluation of the economic impact of a policy intervention at the level of a programme. There are policy evaluations which do not address the output or impact or behavioural additionality of the policy intervention. However, such activities and reports often merely collect and report administrative information on what has been done with the programme budget, who participated and which activities have taken place. However, the major methodological problem is to evaluate the relationship between research policy interventions and the behaviour of researchers (at different levels: actors or systems).

The OECD (2006) report on "Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality" focuses on measuring and evaluating another object, namely the company. Companies are of course a very important source of information and object of analysis when the evaluation questions concern the impact of innovation. The methodologies listed in Table 29 show that (phone-) interviews and questionnaires are important methods for data collection in these type of evaluations.

Table 29: Methodologies used to measure behavioural additionality at company level

Country	*Programme*	*Methodology*
Australia	R&D Start programme	100 firms interviewed by telephone or in person
Austria (Case 1)	Austrian federal R&D support scheme (FFF)	Compares survey responses about hypothetical scenarios (1 000 firms) to actual consequences documented in administrative records (420 firms)
Austria (Case 2)	Kplus funding initiative	Compares a questionnaire-based survey of 118 firms (75% of those surveyed) with responses to the 3rd Community Innovation Survey
Belgium	IWT support programme	Telephone interviews plus additional in-take interviews for large R&D-intensive firms
Finland	Tekes funding programme	Questionnaire-based survey (193 respondents)
Germany	Public R&D project funding	Data form CIS Germany: 659 firms Telephone interviews: 203 responded (39% response rate)
Japan	R&D projects of NEDO	Interviews and questionnaires (501 firms and other institutions responded)
Korea	General R&D funding	Econometric analysis based on public and private sector R&D data
Norway	Loans and grants from Innovation Norway	Interviews (807 firms responded, 67% response rate)
United Kingdom	SMART and LINK initiatives	10 in-depth case studies of firms looking at grant histories
United States	Advanced Technology Programme	Online survey with follow-up by telephone interview (81% response rate)
EU	5th Framework Programme for Research and Technology Development (FP5)	Questionnaire survey: 1 700 responses Also survey to rejected applicants

Source: Georghiou and Clarysse (2006).

Besides the differences in the object of evaluation, evaluations have different possible aims and different tasks. This all leads to different designs of evaluation methodologies.

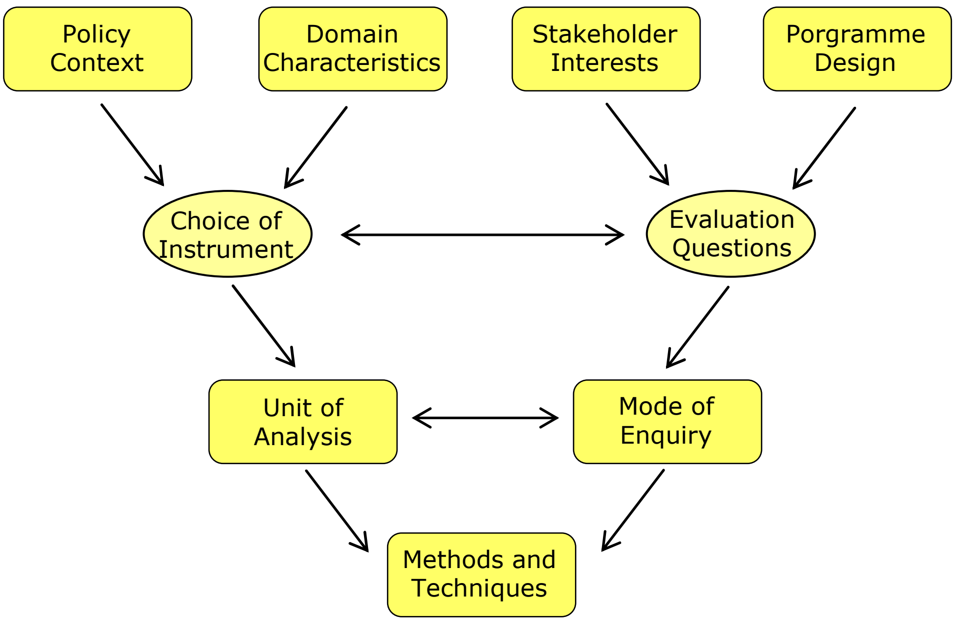
According to Georghiou et al. (2006) it is important to specify why an evaluation was undertaken. Apart from making good use of results of the research, policymakers may also start an evaluation with the aim:

- To understand the effects of policies & programmes.
- To learn from the past.
- To establish whether the policy rationale is being fulfilled.
- To justify continuation.
- To comply with legal requirements.

B.1.2 Designing appropriate evaluation methodologies

The methodology of evaluation should be part of the programme design. This is important to mention since the party that is evaluated usually has to deliver data and information to the evaluator. It is not a simple choice of instrument but a design process that involves several interacting steps. Figure 30 below shows the process in terms of steps and decisions that can lead to the appropriate methodological design of an evaluation. By going through the steps in this figure policy makers and evaluators can select the appropriate set of evaluation instruments fit for the evaluation purpose. The fact that there are many aspects that have to be taken into account in the process of designing an appropriate evaluation methodology implies that there is no best practice model or optimal design. It also implies that it is very difficult to compare the results of evaluations, because the methodologies are often different.

Figure 30: Steps in designing the appropriate evaluation methodology



Source: Boden and Stern (2002).

The audience and possible users of the evaluation may include:

- Policymakers, including politicians, administration officials, but also councils;
- Programme managers, acting on behalf of policymakers or agencies;

- Participants in the programme, public and private actors conducting the research;
- Other stakeholders such as those representing industry and consumers.

The formulation of the evaluation questions depends not only on the type of programme and its design features but also on the interest and involvement of the different stakeholders.

The policy context, the characteristics of the scientific and technological domain and the design and management of a programme will also determine how the results of an evaluation will be used (see Fahrenkrog et al., 2002). The different stakeholders may all have differing expectations of the design and outcome of an evaluation and differing benefits of evaluation results.

An interesting trend is the wider involvement of stakeholders in the evaluation. For instance, in the UK there are public consultations which evaluate the public attitude towards stem-cell research. In Canada a national evaluation of the country's science and technology system has been conducted recently by means of a survey, amongst others, of some 1300 researchers in the system asking them about the benefit of some public policies and institutions. Certain methods can be applied to more than one type of assessment. Some methods or approaches are correctly considered as ways of generating data about economic and social phenomena. These are not necessarily theory blind but their use is generally with a view to collecting data and reporting and categorizing it. They include, for instance, the reporting on monitoring data that has been produced during the life of a programme. These are the sort of basic desk research activities that each evaluation starts and often stops with, after representing the information found in existing documents. For the more serious evaluations we can categorize the methods (see "Programme Evaluation" is defined as a judgement about the quality (performance, scientific quality, impact etc.) of a whole programme. Programme evaluation could be ex-ante, accompanying, interim (after certain years), ex-post or backward look (after the end of the programme) and in most cases it is carried out by external experts".

Table 30) in three groups, distinguishing between the kind of conceptual framework, the way of collecting data and the type of analysis.

The thing that's missing in the above categories of methods is the element of judging and the element of policy learning and the usage of the evaluation by stakeholders.

In the guidelines on evaluating EU Activities from the Directorate General for the Budget (European Commission 2004) this element is seen as the fourth major task. These four tasks are implemented largely in a sequential manner:

- providing a focus and structure to the evaluation project
- collecting data in the field
- analysing data collected in the field and from other sources
- providing judgements.

According to the Handbook Guide "Good practices for the management of Multi Actors and Multi Measures Programmes (MAPs) in RTDI policy" on design, implementation and evaluation of MAPs by the MAP Thematic Network this element of judgement is even central in the definition of a programme evaluation:

"Programme Evaluation" is defined as a judgement about the quality (performance, scientific quality, impact etc.) of a whole programme. Programme evaluation could be ex-ante, accompanying, interim (after certain years), ex-post or backward look (after the end of the programme) and in most cases it is carried out by external experts".

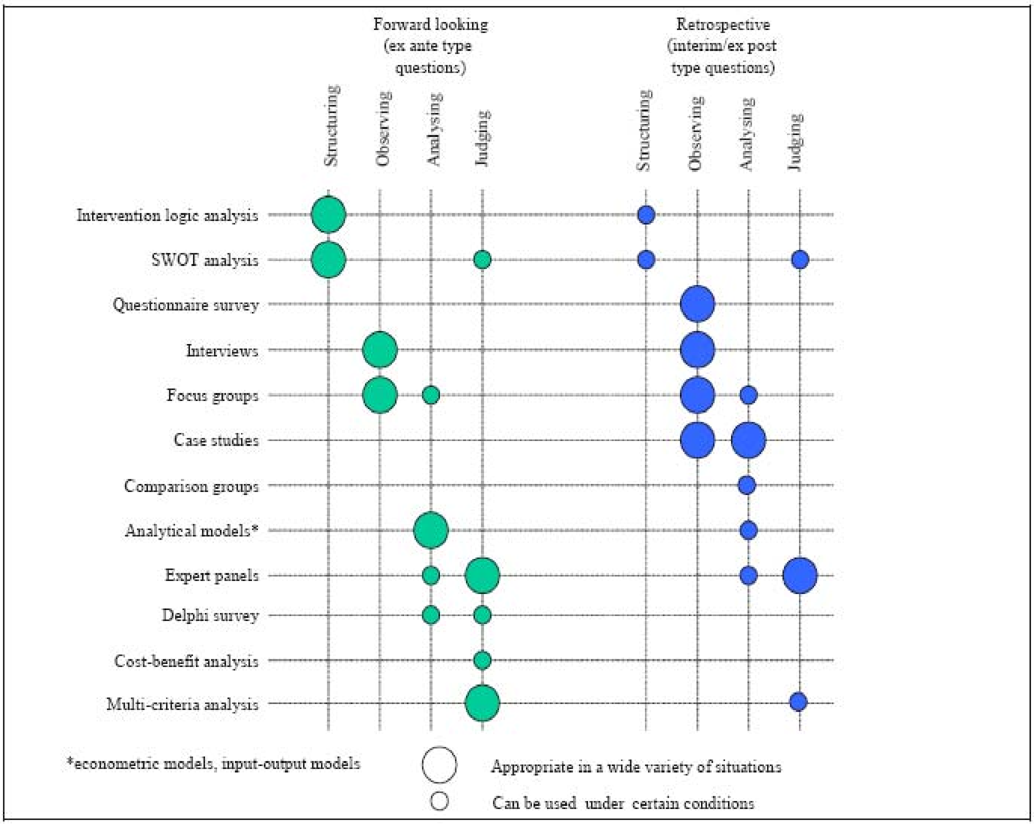
Table 30: Categories of methods

Conceptual framework for evaluation	before/after comparison "control group" and counterfactual approaches logical frameworks
Method of data collection	interviews surveys statistics/documents
Method of data analysis	case-studies econometric modelling analysis of indicators cost-benefit analysis

Source: Georghiou and Meyer Kramer (1992)

Table 31 shows the relation between different methodologies used in evaluation and the type of evaluation. It shows the appropriateness of the different evaluation methodologies. For instance, SWOT analysis is appropriate for ex-ante evaluations, whereas surveys or interviews are more suitable in ex-post evaluations.

Table 31: Benchmarking of methodologies



Source: Evaluating EU Activities: A Practical Guide for the Commission Services, DG Budget, Evaluation Unit, July 2004.

B.1.3 Benchmarking methodologies: indicating appropriateness of methodologies

In general, the importance of benchmarking has increased since the 1980s. The debate about favourable institutional and regulatory conditions in some countries led to a debate about favourable localisation factors. A number of international organisations support national governments in their benchmarking efforts, such as the OECD, the EU or the ILO. Globalisation is leading to increased pressure on national governments to adjust regulatory frameworks in favour of domestic firms and organisations. The pragmatic attitudes of governments result in the adjustment of regulatory regimes and programmes in accordance with best practice examples in other countries.

For the task of quality judgement expert panels are the most appropriate approach according to the benchmarking of methodologies in the matrix shown in Table 31. Interviews and focus groups are mentioned as appropriate tools for observation.

The importance of the user-oriented steps after the analysis is also emphasized by Georghiou et al. (2007) in steps 5 and 6 (The methods of peer reviews and benchmarking deserve special attention on the programme level especially in an international context. However, it is very difficult to quantify the appropriateness of a method or measure how well the methodology matches the policy instrument or indicate a level of suitability.

Moreover, in practice the adopted method of evaluation is almost always a portfolio of methods. One of the main conclusions of the OECD (2006) report on Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality is that *"a range of different methodologies can be used for measuring behavioural additionality, each with its own strengths and weaknesses […] a robust approach would combine methodologies" (OECD, 2006; p.8).* This is not a new conclusion but nonetheless it is relevant since most of the literature agrees on the fact that a robust approach consists of a targeted combination or portfolio of methodologies or tools.

A major trend in evaluation methodologies is the attention given to the dynamic and systemic context in which a certain policy intervention is embedded (for example, in Georghiou et al. 2006, Ruegg 2006). This is in line with theoretical developments that stress the importance of a systemic perspective on innovation (Edquist 1997).

A number of qualitative and quantitative evaluation methods exist. According to Bryman (2000) the particular strength of qualitative methods is the focus on processes from the perspective of the actors, whereas quantitative methods focus on static analyses of structural patterns primarily from the perspective of the researcher. Evaluation studies increasingly use a mix of different methodologies. It can be argued that evaluators can have more confidence in their research results if they are "produced" through different methods. This is also the general logic behind triangulation. According to Palmberg (2003, p. 36), "triangulation refers to the combination of different methodologies for securing different types of validity (i.e. methodology triangulation)". Qualitative and quantitative methods are different methods of studying the same phenomenon. This is also in line with Calidoni-Lundberg (2006, p. 30) who argues that "triangulation and mixed-methods evaluation is therefore the new frontier of evaluators' work because it offers much for increased understanding of programmes".

Table 32) of the evaluation process, concerning the dissemination and the use and uptake of the evaluation results. In total it is suggested that there are six steps which should be taken into account when an evaluation is being considered. These are shown in The methods of peer reviews and benchmarking deserve special attention on the programme level especially in an international context. However, it is very difficult to quantify the appropriateness of a method or measure how well the methodology matches the policy instrument or indicate a level of suitability.

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Table 32.

The methods of peer reviews and benchmarking deserve special attention on the programme level especially in an international context. However, it is very difficult to quantify the appropriateness of a method or measure how well the methodology matches the policy instrument or indicate a level of suitability.

Moreover, in practice the adopted method of evaluation is almost always a portfolio of methods. One of the main conclusions of the OECD (2006) report on Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality is that *"a range of different methodologies can be used for measuring behavioural additionality, each with its own strengths and weaknesses […] a robust approach would combine methodologies" (OECD, 2006; p.8)*. This is not a new conclusion but nonetheless it is relevant since most of the literature agrees on the fact that a robust approach consists of a targeted combination or portfolio of methodologies or tools.

A major trend in evaluation methodologies is the attention given to the dynamic and systemic context in which a certain policy intervention is embedded (for example, in Georghiou et al. 2006, Ruegg 2006). This is in line with theoretical developments that stress the importance of a systemic perspective on innovation (Edquist 1997).

A number of qualitative and quantitative evaluation methods exist. According to Bryman (2000) the particular strength of qualitative methods is the focus on processes from the perspective of the actors, whereas quantitative methods focus on static analyses of structural patterns primarily from the perspective of the researcher. Evaluation studies increasingly use a mix of different methodologies. It can be argued that evaluators can have more confidence in their research results if they are "produced" through different methods. This is also the general logic behind triangulation. According to Palmberg (2003, p. 36), "triangulation refers to the combination of different methodologies for securing different types of validity (i.e. methodology triangulation)". Qualitative and quantitative methods are different methods of studying the same phenomenon. This is also in line with Calidoni-Lundberg (2006, p. 30) who argues that "triangulation and mixed-methods evaluation is therefore the new frontier of evaluators' work because it offers much for increased understanding of programmes".

Table 32: The Major Stages of the Research Process

Major Stages of the Research Process					
Step 1	*Step 2*	*Step 3*	*Step 4*	*Step 5*	*Step 6*
Evaluation Priorities	Research Questions and Frameworks	Data Acquisition	Data Analysis	Reporting and Dissemination	Feedback and Use of Findings
What is being assessed?	How will the research be done?	How will the data be obtained?	How will the data be analysed?	How will the findings be reported and disseminated?	How can the evaluation findings be used?
Assessing causal relations Net effects Measuring Issues	Deciding the Research Dimensions - Choosing the Research Relation, Timing, Focus, Methods, Paradigm and Scope	Applying the Frameworks and Methods to Generate Data	Use of Deductive, Inductive and Abductive (Levis-Rozalis, 2000) Methods to reach Conclusions and Recommendations Based on the Data	Use of the Evaluation Findings by Policy-Makers/ Academics Stakeholders – Cox (1977) notes the problems	Applicability for Current Programmes, Future Programmes, and for Impact Assessment Methodology

Source: Georghiou et al. (2007)

B.2 Methodologies to evaluate R&D programmes

This part of the compendium describes the methodological approaches that are most frequently used in evaluation.

B.2.1 Qualitative interviews with management, beneficiaries, stakeholders and peer review

Introduction

Interview methods are generally divided into three sub-types, unstructured, semi-structured and structured. Interviews promise significant depth and understanding of effects which cannot be known in advance (Georghiou et al. 2007; p.209). They are particularly useful in the context of identifying new processes that have an impact. Structured methods are similar to questionnaire surveys, except that the questionnaires are intended for impersonal administration and can therefore be sent to a higher number of potential respondents.

According to the European Commission/IPTS (2002), approaches to evaluation have evolved from a purist model of "objective neutrality" characterised by independent evaluators producing evaluation outputs containing evidence and argument (but no recommendations), to more formative approaches in which evaluators act as process consultants and mediators in learning exercises involving all relevant stakeholders, providing advice and recommendations as well as independent analysis.

Interviews are part of almost any evaluation but they can have different purposes in combination with other methodologies, for example, more quantitative results can be discussed with stakeholders in in-depth face-to-face interviews. When more people are interviewed at the same time it becomes more of a focus group. However, the focus group approach is different from interviews since the particular focus of a focus group is the interaction within the group.

The method of interviews with management, beneficiaries and stakeholders is also known under different names and approaches, for example, the methods of expert judgement and peer review. Expert judgement and peer review methods have been increasingly used in recent years and comprise a wide range of sub-types. Their suitability for socio-economic impact assessment stems from the relative absence of common measures of output or impact. Where impacts are likely to be delayed, expert judgement provides a proxy or estimate of impact rather than an actual measurement of it.

Example of application and good practice

The OECD peer-reviews are a good example. They define their methodology as follows: "the systematic examination and assessment of the performance of a State by other States, with the ultimate goal of helping the reviewed State improve its policy making, adopt best practices, and comply with established standards and principles" (OECD 2002).

Peer reviews based on interviews are used widely by the OECD in several policy areas such as unemployment, development assistance, economic policy, education, etc. In the area of trade policy they are used at the WTO for environment policies at the UN, for labour market policies by the EU, etc. "Science Policy Reviews" have long been conducted at the OECD - since the early 60s, supplemented by "Technology Policy reviews" in the 70s and "Science, Technology and Innovation Policy Reviews" since the mid-80s (Aubert 1997).

Required data and conditions

The main characteristics of peer reviews according to Wintjes (2002) are:

- Peer reviews are a goal-oriented approach: the required data includes judgement. Peer reviews go beyond pure analysis as they aim at improving practices;
- The voluntary engagement: both the reviewers and the reviewed decide to undertake the exercise on the basis of their genuine interest;
- The frequent presence of an intermediary, neutral organization (such as the OECD Secretariat) acting as an organizer of the exercise (sometimes taking on the bulk of the analytical work);
- The credibility of the recommendations produced by peers (as opposed to recommendations by consultants, external to the policy-making process) the so-called "peer pressure";

- The dialogue created between reviewers and the reviewed helps create an understanding of the working of the innovation policy system, taking into account the tacit knowledge held by the policy-makers reviewed. The learning process can therefore become multilateral rather than unilateral.

Steps for implementation

In the case of peer reviews the process has several phases:

- It is a three-phase process consisting of a preparation phase (background analysis by the reviewed country), a consultation phase (dialogue, interviews and analysis between reviewers and reviewed, often including visits), a recommendation phase (adoption of the peer review report often through a high-level meeting and diffusion).

- The reciprocity and shared interest of all parties in the exercise: normally, the same actors would be likely to act as reviewed or reviewer on different occasions;

- The process should be conducted at several points in time thus allowing a measurement of progress and an analysis of trends. Continuity also helps to build trust and develop further co-operation practices beyond the peer review itself, creating a community of interest between a range of policy-makers.

Scope and limits

The limitations of interviews with managers, beneficiaries and other stakeholders include the subjectivity of the respondents. Especially programme managers have an interest in positive evaluations. Interviews with other stakeholders can transform this subjectivity into a more balanced inter-subjectivity.

With regards to interviews and peer reviews as a method for evaluation, the limitations are the following:

- The reliance on established norms and principles or benchmarks: peer reviews have generally been used to assess distance from and of progress relatively well established principles and norms (for example the share of development aid in GDP or rates of emission of certain substances), which do not exist as such in innovation policy.

- The wide scope of the exercise as it covers a multiplicity of policy areas.

- The difficulty for reviewers to gain sufficient knowledge of the context of the programme under review.

- The heavy time investment needed to carry out the exercise properly; the difficulty in finding experienced policy-makers prepared to invest such an amount of time.

B.2.2 Case studies

Introduction

Case studies can be used as a methodological tool for data acquisition and data analysis, allowing for in-depth, self-contained studies embedded within a larger study or evaluation. Among those generally used as methodological instruments for ex-post evaluations, three main types of case studies can be distinguished: exploratory, descriptive and explanatory. Exploratory case studies are used as a first step to develop a better understanding of key issues, subsequently to be followed by a more focused round of data collection and analysis. Descriptive case studies serve to illustrate less in-depth analyses with specific and detailed information about objects of the case study. In order to test hypotheses across a relatively limited number of cases exploratory case studies are used searching to replicate specific results or processes. (European Commission 2004).

Case studies serve to collect and analyse both quantitative and qualitative data on the context and case. A variety of information sources and tools are used to search for patterns in data and with the aim of triangulating (also called "cross examination") to underpin the validity of findings.

In his landmark book on case studies Yin states, “In general, case studies are the preferred strategy when ‘how’ and ‘why’ questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon with some real-life context.” (Yin 1994, p.1).

Examples of application and good practice

A recent benchmarking workshop among various S&T programmes in several countries revealed that case studies are used as one of the main evaluation methodologies. Programme administrators from Finland’s Tekes Programme, Canada’s Industrial Research Assistance Programme, Israel’s MAGNET Programme as well as programme administrators from the U.S. National Science Foundation, National Institutes of Health, the Department of Energy’s Office of Science and Office of Energy Efficiency and Renewable Energy, the National Institute of Standards and Technology’s Advanced Technology Programme all noted the importance of case study methodology to their evaluation efforts. (Ruegg 2003).

Following Yin’s arguments, the popularity of the case study methodology can be explained by the fact that many public R&D programmes have numerous applications that meet case study conditions. Typically case study investigators have the status of third parties with no control over to-date developments that occurred in real-life project contexts. Often, they have the task of finding out and documenting how the research projects turned out and why; how and why a project had a strong, weak or no impact on innovation; and why stakeholders turned to the government for funding.

The case study approach applied to evaluate the NIST Advanced Technology Programme (ATP) (see text box below) might serve as an example of good practice.

The *Advanced Technology Programme* (ATP), since its birth in 1990, has had an active evaluation programme with a dedicated staff and budget. With the implementation of the Government Performance and Results Act (GPRA) in 1994 ATP was (and is) a leader in using several methods for the evaluation of the programme and using the findings for computing performance metrics. In 2002, the President's Management Agenda added additional requirements aimed at improving performance management practices of federal agencies. These requirements known as the Programme Assessment Rating Tool or PART, include new investment criteria for federal R&D programmes. The Office of Management and Budget (OMB) and individual government programmes perform PART scoring separately.

The ATP's evaluation effort seeks not only to measure the short-, medium, and long-run impacts of the projects but also to increase those impacts. ATP's evaluation is carried out by its Economic Assessment Office (EAO) which utilizes the assistance of academic and consulting economists in addition to its internal staff. Evaluation activities include planning, developing evaluation models and methods and collecting data and constructing databases. They also include conducting micro- and macro-economic case studies, statistical and econometric analyses and other forms of assessment and inquiry. Programme effectiveness is measured in terms of:

- Inputs (programme funding and staffing necessary to carry out the ATP mission)
- Outputs (research outputs from ATP supported projects)
- Outcomes (innovation in products, processes and services from ATP supported projects)
- Impacts (long term impacts on U.S. industry, society, and economy)

Source: http://www-15.nist.gov/factsheets/1-a-3.htm

Required data and conditions

Given the variety of methods for collecting data for evaluation purposes case studies are considered to provide rich contextual information and a good understanding on how contexts affect and shape impacts. However, results stemming from case studies are not generalisable. Nevertheless, a big advantage of case studies is that they can focus on processes from the perspective of the participants which increases the systemic and dynamic understanding of the measure that is evaluated. In contrast, quantitative approaches (for example, statistical analyses based on questionnaires) frequently apply a static view based on the perception of the evaluator. As each technique has its own strengths and limitations, the adoption of appropriate approaches in data collection might reduce the data collection bias (Fahrenkrog et al., 2002).

Data requirements will vary with respect to the case study type, the stage at which an R&D instrument is applied, the issues being addressed and the skills and time available. Project and programme information will serve to produce input, output, outcome and the impact indicators accordingly, measuring the output and outcome of the policy instrument. As shown by the ATP best practice example in the previous section a smart combination of various indicators can be considered as key to this exercise.

Steps for implementation

The steps for implementing case study methodologies might vary according to project particulars such as objectives, timing of the study, market application, data availability, as well as research expertise, study budget, and the research perspective.

Case studies generally serve as a data acquisition and data analysis tool for ex-post evaluations. They are considered to be best suited to those kinds of ex-post evaluations where socio-economic impacts are to be understood within a complex system, rather than in terms of simple proxy measures. In particular, case studies techniques are especially suitable for evaluating micro-economic impacts. In addition, case study methodologies are generally applicable for evaluating meso-economic impacts as well as for assessing impacts on social employment and social quality (Georghiou et al. 2007).

Scope and limits

As highlighted in the previous sections case studies are best applied to exploratory and descriptive investigations and are less useful for testing causal relationships. Hence case studies should be seen as a methodological channel to understand how particular contexts affect and shape impacts according to different settings (Fahrenkrog, 2002). A number of advantages and disadvantages have to be considered with regard to the case study methodology. Ruegg (2006) mentions the following advantages:

- Easy to understand and remember.
- Richness of detail may be useful in formulating theories and hypotheses and for understanding 'how' and 'why' questions.
- Good for documenting experiences and providing a benchmark and for application on other projects as well as for capturing a holistic view.
- An economic case study relates project outcomes to inputs and provides quantitative measures in the language of finance.

Nonetheless, the following disadvantages limit the usefulness of the case study approach:

- Descriptive case studies generally provide anecdotal evidence which lacks robustness as evidence of a programme's effectiveness.
- The focus is on the individual project not on the programme's portfolio of projects.
- Results for single projects and small clusters of project usually cannot be generalised.
- Important benefits in an economic case study may be difficult or impossible to capture in monetary terms.

B.2.3 Analysis of monitoring data

This type of analysis represents the data that is reported during the programme, for example, the progress reported in interim reports or mid-term reviews. It is one of the first, most basic and simple, and also the cheapest element in almost every programme evaluation. The methods which could be used to analyse the data are essentially the same as for other evaluation data. Therefore we don't describe them in further detail here.

B.2.4 Control-group approaches

Introduction

A number of evaluation methodologies apply qualitative approaches. However, more systematic approaches require a longer time series of information to allow for a comparison of before and after the project was finished. Particularly interesting is the comparison of beneficiaries who received funding from the research programme and non-beneficiaries who conducted similar research projects and had similar structural characteristics. It can be argued that without the full array of time series data and comparative control data it is not possible to conduct long-term and reliable assessments of the performance and impact of research programmes. To obtain these reliable estimates of programme impacts is perhaps the hardest part of the evaluation process. By definition the impacts of a programme are those outcomes that it caused to happen and hence would not have occurred without it. For this reason measuring the impact of a programme requires a comparison of its outcomes for a sample of beneficiaries with an estimate of what these outcomes would have been for the same group in the absence of the programme funding.

For such a comparison of beneficiaries and non-beneficiaries a control group approach can be applied in order to evaluate research programmes. According to Ruegg and Feller (2003), control groups are generic techniques used to determine whether the observed changes would have occurred even without the programme. There are many different control group options particularly in the field of control group design. A comprehensive differentiation of control group designs can be made according to the selection process of control and experimental groups. In the following three different control group designs are introduced:

- Experimental designs
- Quasi-experimental designs
- Non-equivalent designs

So-called experimental designs are characterized by a random selection of experimental and control groups. Both groups must be from the same population and statistically equal. By contrast quasi-experimental designs utilise matching instead of random selection, taking beneficiaries as the experimental group and non-beneficiaries as the control group. Furthermore, quasi-experimental designs occasionally involve time series analysis in order to collect longer time periods and a sufficient number of different events to control for various threats to validity and reliability (Campbell and Stanley, 1971). Internal validity is threatened when extraneous variables are able to generate effects that cannot be disentangled from the effects of the experimental stimulus (Brown et al, 1994). In cases of research programme evaluation the most widely used approach is the non-equivalent design. It is very similar to quasi-experimental designs and is an evaluation method in which the different groups of participants are formed under conditions that do not permit the researcher to control the allocation of individuals to groups because these groups already exist. The groups of participants are therefore considered non-equivalent whereby non-equivalent merely means that statistical equivalence cannot be assumed because random assignment to experimental and control groups is not implemented (Brown et al, 1994).

The subsequent details are focused on approaches presented by Kinsella in European Commission (2002) and the European Commission (2004) which in particular deal with the evaluation of research programmes. A basic principle of this control group approach is the comparison of a control group to an experimental group in a test of a causal hypothesis in the context of an ex post evaluation. The control group and the experimental group should be identical in all relevant ways except for the introduction of the variable that the analyst is interested in. The most widely used method for establishing a counterfactual is to observe outcomes for a control group that did not have access to the programme. This enables a quantitative estimation of the counterfactual situation and consequently emphasises the net effect of the research programme. As a result the use of control groups in evaluation becomes very attractive.

According to Kinsella in the European Commission (2002), three different groups of actors may be defined:

- Group 1 consists of those who participated in the research programme (the beneficiaries),
- Group 2 consists of those who applied unsuccessfully for funding. However, members of this group completed the project using their own funds or other support mechanisms (for example, venture capital, loans). The only difference between group 1 and group 2 should be that members of group 2 did not receive funding under the research programme.
- Group 3 consists of those who did not seek funding under the research programme but executed a similar project using their own funds or other support means.

Due to the fact that pre-existing groups are simply compared and that the groups are not randomly selected, this approach converges to a form of non-equivalent design. It employs the logic of comparing beneficiaries of the research programme with similar non-beneficiaries of the research programme. Thus the only variable that is different is whether the group took part in the programme or not. However, we can assume that members of group 1 are on average more experienced in submitting research proposals and in carrying out R&D. Groups 2 and 3 represent control groups.

When applying the control group approach, the performance of group 1, i.e. the beneficiaries of the research programme under consideration is compared with the performance of samples taken from the control groups 2 and 3. The control group approach compares the same indicator variables and measures for all three groups. It is assumed that data for input, output and impact indicators is available for group 1.

The differences between the outputs and impact on in groups 1 and 2 are used to evaluate the effect of the instrument, where as the corresponding differences between groups 1 and 3 principally reflect the effectiveness of the operation and management of the instrument.

Examples of application and good practice

As mentioned above, the control group approach supposes that the groups are as similar as possible in order to allow for meaningful comparisons with regard to programme participation. However, this matching is difficult with large consortia. A number of research programmes support networks of different actors. To find a matching network of non-participants is a difficult endeavour.

According to Luria and Wiarda (1996), the Michigan Manufacturing Technology Center (MMTC) was evaluated by using a control group approach. Since 1991 the MMTC has established a database of performance metrics, tracking changes over time for both MMTC clients and a non-client control group. This data coupled with a detailed scheme for characterizing heterogeneous MMTC interventions provides the raw inputs for an analysis of the impact of MMTC operations.

Required data and conditions

In general, it is an ambitious task to gather data about impacts of research programmes. In many cases it may be difficult to separate impacts due to the programme from those arising simultaneously from other unobservable influences and spillovers from the same or other sectors of the economy (Kinsella in European Commission 2002). There may be many indicators related to impacts that are important but non-quantifiable, such as the enhancement of reputation among peers, building of R&D capability and networks, increasing management levels in R&D projects, increasing international capability through participation in international networks.

There are a number of different data collection methods, for example postal surveys, face to face interviews, case studies, or focus group discussions. Each method of collecting data has its strengths and weaknesses and there are different associated costs. The associated costs are significantly influenced by the data collection method selected. Like most other aspects of planning an evaluation, planning for data collection should be carefully linked to other considerations. A number of questions are important with regard to data collection:

- How can beneficiaries and non-beneficiaries be motivated to provide the data needed? The data required is often closely guarded by firms.
- How can the intervention be characterised? Research projects are often tailored to specific needs of firms leading to a large variation. This makes it difficult to design a control group.
- What kind of outcome/impact measures should be included? Outcomes and impacts are often time-dependent and difficult to disentangle from other measures.

According to the European Commission (2004) the investigation refers to firm and industry level. Thus the required data mostly consists of micro data such as expenditures, profits and patents.

In order to evaluate research programmes it is essential to determine indicators that measure the performance and impacts of research programmes. In the following, some examples of indicators that can be collected are given:

- Variables related to objectives and targets: for example, numbers of first time R&D performers; encouraging the formation of consortia
- Input indicators: for example, variables related to the budget of the programme.

- Management and operation: for example, effectiveness; speed of the selection process.
- Output indicators: for example, publications, patents.
- Impact indicators: for example, changes in level of employee education; increases in sales.

Steps for implementation

Identification of potential participants for control groups is an easy task. Members of the experimental group, group 1, can be easily identified and contractually obliged to participate. It is possible to identify members of group 2 through the funding agency. However, there is a risk that their responses may be biased against the funding agency since they did not receive funding. Members of group 3 can be identified by discussion with research associations, professional bodies, chambers of commerce or universities. They can be identified through publicly available databases. They can also be former participants of research programmes.

By contrast, stratification is a very complex task. Following Kinsella in European Commission (2002), the scope to which stratified samples are possible or realistic obviously depends on the size of the population and the degree of stratification. Indeed the information provided by group 1 will be complete but that of group 2 and 3 is unlikely to be so. Hence the researcher is forced to use all of group 1 and a self-selecting sample of group 2. As a result this doesn't allow a deliberate stratification and consequently simply provides a statistical comparison.

Thus it appears that alternative methods are necessary in order to stratify and compare the groups. One option might be to select applicant consortia from the groups, by an analysis of the data. These consortia can be matched in pairs giving a one on one comparison. These matched pairs would be closer to having a true control group. Another option could be to carry out a limited number of case studies on closely matched pairs from the groups. According to Kinsella in European Commission (2002) these case studies could generate deeper insights into support mechanisms and reasons for non-participation especially in the case of matching pairs of group 1 and group 2, as well as group 1 and group 3.

Scope and limits

As stated above a major advantage of the control group approach is that it captures the impact of policy intervention on the programme participants. Thus this approach is the preferred one when the aim is to point out the programme impacts (Kinsella, in European Commission 2002).

Due to the fact that the results and the level of confidence depend on the completeness and reliability of the data collected, this approach requires high technical capacity and a significant amount of data. Thus the implementation is costly. Ruegg and Feller (2003) state that "the larger and more differentiated the control groups, the more expensive the project and the more difficult the conduct of the evaluation". Control group approaches require the participation of beneficiaries and non-beneficiaries. According to the European Commission (2004) the most notable practical problems are:

- Obtaining contact details of non-addressees
- Persuading them to reveal the required information
- Finding non-addressees that are of a sufficiently similar profile to addressees
- Finding non-addressees not indirectly affected by an intervention

Furthermore, control group designs are weakened by the type of selection bias that often occurs when non-participants are used as controls. This is deemed to be a major weakness of control group approaches. Feller (1991) quoted by Brown et al (1994, p. 671) points out that "[gaps] in baseline data, control groups, and other design components may have become so large that only qualitative assessments are now feasible." In addition, Kinsella in European Commission (2002) supports this statement by saying "given the difficulty, if not the impossibility, of establishing clinical control groups, this approach will not solve the problem, and results must be interpreted very cautiously."

B.2.5 Survey of beneficiaries

Introduction

The survey is a non-experimental, descriptive research method. Surveys can be useful when a researcher wants to collect data on phenomena that cannot be directly observed. In a survey researchers sample a population. Busha and Harter (1980) state that "a population is any set of persons or objects that possesses at least one common characteristic". Surveys are a useful instrument to collect data from beneficiaries. They usually take the form of questionnaires with questions that cover facts and opinions from beneficiaries during intermediate and ex post evaluations. The questionnaires can have different formats. They can include closed-end questions that enable a (multiple) choice of quantitative or qualitative responses. Questionnaires usually include open questions as well, where the respondents have the possibility to provide more qualitative information and comments. The responses of the questionnaires can be analysed to produce quantitative data about an intervention's effects and other mechanisms.

Ruegg and Feller (2003,p. 29) state that "surveys can be used to describe a programme in terms of frequencies, percentages, means, medians, standard deviations and the significance of sample data. Survey results are typically presented in aggregate, without identifying individual results using tabular and graphical summaries of data. Surveys provide a statistical overview for multiple projects and participants, rather than project details, and are particularly useful in portfolio analysis".

According to Babbie (1973) there are two basic types of surveys:

- Cross-sectional surveys: these are used to gather information on a population at a single point in time.
- Longitudinal surveys: these are used to gather data over a period of time.

There are three common ways to get information in order to carry out a survey. These are:

- Telephone surveys. They are the fastest method of gathering information from a relatively small sample. The interviewer follows a prepared script that is basically the same as a written questionnaire. However, unlike a mail survey, the telephone survey allows the opportunity for some opinion probing. Telephone surveys are a relatively fast and cheap way of data collection. Potential misunderstandings and obscurities related to the questions can be sorted out. However, it can be difficult to arrange telephone surveys. It is difficult to establish a personal relation between interviewer and respondent which can lead to refusals to participate. The time for telephone interviews is usually limited and the environment can disturb the interview. There is also a risk of less thought-out answers.

- Mail surveys. They are a cost-effective method of gathering information. They are ideal for large sample sizes, or when the sample comes from a wide geographic area. They cost a little less than telephone interviews, however, they take over twice as long to complete. Because there is no interviewer, there is no possibility of interviewer bias. However, obscurities related to the questions cannot be sorted out which can cause misunderstandings and "wrong" answers. In addition, there is no opportunity to probe respondents for more detailed information.

- E-mail and internet surveys. They are relatively new and little is known about the effect of sampling bias in internet surveys. While it is clearly the most cost effective and fastest method of distributing a survey, the demographic profile of the internet user does not represent the general population, although this is changing. An internet survey has to take into account increased non-response because of technical problems. Only respondents that have access to the internet can be included in the survey which can introduce a bias.

The design of the questionnaire is a critical step since the questions need to be able to elicit the most relevant responses. This assumes a fairly good level of prior knowledge with respect to the target groups, the intervention, likely effects etc. Thus, evaluation through a survey requires thorough preparatory work which can be accomplished through prior interviews or focus groups. The advantage of surveys is that a survey questionnaire can be designed to generate bottom-up quantitative data about the counterfactual situation (European Commission 2004). Generalisations of the results from survey analyses are possible in the case of a large number of responses. This requires good knowledge of sampling techniques.

Non-response is a serious problem in most survey studies. Non-response means that units were asked to participate in the survey but did not do so for different reasons. There are a number of different reasons for non-response. The study units could have been out of town, contact addresses could have been outdated, units could have simply refused to participate; but there can even be technical reasons for not participating. The consequence of non-response is that it can distort the results. It can be difficult to generalise the results to the whole population or to compare beneficiaries with non-beneficiaries.

Examples of application and good practice

Surveys are rarely used in evaluations of R&D programmes. However, surveys are frequently used to assess the importance of innovation. One particular important initiative is the Community Innovation Survey (CIS) which started as a joint action between Eurostat and DG Enterprise. The OECD had already conducted trial innovation surveys in the early 1990s. The CIS follows the definitions of the Oslo Manual (OECD 1992). CIS is a large-scale attempt to collect internationally comparable data about direct measures of innovation outputs (Smith 2005). The survey collects data at the disaggregated level of individual firms. The CIS covers data about a large variety of variables related to innovation, for instance, expenditures on activities related to innovation, outputs and sales from innovative products, sources of information relevant to innovation and technological collaboration. It also covers data about the obstacles to innovation and factors that promote innovation. The literature that exploits innovation survey data is growing. There are a large number of publications in scholarly journals that cover econometric or statistical studies of innovation. In addition, there are a large number of analytical studies sponsored by the European Commission (see Smith 2005 for an overview).

Required data and conditions

Surveys represent the most commonly used instrument for data collection. According to Ruegg and Feller (2003) survey data can be collected by:

- Interviews conducted in person or by phone,
- Questionnaires mailed, dropped off, or posted on the Internet.

Following Stier (1996) questions may be presented in a standardised, partial-standardised and also non-standardised form. Standardised, in this case, simply means that all interviewed persons are posed the same questions in the same order. The design of single questions as well as the entire questionnaire may turn out very different depending on the selected interrogative form. According to Ruegg and Feller (2003) questions may be either close-ended or open-ended. Close-ended questions may use ranking systems and scales. Open-ended questions should be coded systematically and consistently in order to allow for advanced statistical analysis. In general, interviews use more open-ended questions and discussions, leading to more varied data that may be more complex to analyse.Questionnaires, on the other hand, use a series of precisely worded, close ended questions. However a questionnaire can also contain open-ended questions, and an interview may rigidly follow a scripted questionnaire format.

Sampling is the key to survey research. No matter how well a study is done in other ways, if the sample has not been properly found the results cannot be regarded as reliable. Persons to be surveyed must be selected randomly from the population in order for the survey's results to be representative. The extent of the sample size depends on how reliable and precise the results should be. A sample is representative when it is an accurate proportional representation of the population under study. However, inclusion coverage and selection of the population are very difficult. A pragmatic procedure in order to avoid the determination of the sample size and the selection from the population is to perform a census study. A statement about the accuracy of the result can be made on the basis of the rate of return. For a determination of the sample size the values must be specified to the significance level and the accuracy level. Statistical inference which is the process of using sample data to make inferences about the parameters of a population, reduces the time and cost of collecting data by survey from an entire population. Sample design should be sufficiently described to enable the calculation of sampling errors. Establishing a sampling frame—the list from which a sample is drawn—is essential. Samples may be randomized or stratified. They may be longitudinal, drawing data from the same panel of individuals at different times with the same survey questions. Or they may be cross-sectional, drawing new samples for successive data collection.

Furthermore, the response rate has to be considerably high in order to allow for a generalisation of the survey results. However, even analysis based on few observations can provide evaluators with usable information. In order to be able to conduct a survey, a sampling frame that contains the contact addresses of the potential respondents is indispensable. It is rather easy to get the contact addresses from the beneficiaries who are often obliged to participate in a survey study for evaluation purposes. A survey can also be used to get information and data from non-beneficiaries. However, it is more difficult to get contact addresses from non-beneficiaries.

Steps for implementation

Once it has been decided that a survey method is appropriate for the evaluation task at hand there are a number of steps involved in carrying it out. The design of the questionnaire deserves attention. Ideally the questions should directly measure what the researcher is interested in. An important step in a survey is therefore, the operationalisation of the concepts that should be measured. A pilot questionnaire should be sent to potential participants to check whether they are able to understand and answer the questions. According to Converse and Presser (1986, p. 54), a pilot study serves a number of purposes. A particularly important goal is testing items for an acceptable level of variation in the population. Furthermore, the meaning of the questions can be assessed through a pilot study, to determine whether the meaning intended by the investigator is shared by the respondents. The researcher has to be aware that the intended meaning of the questions in the questionnaire is often not the meaning that the respondents interpret. Task difficulty can be tested with a pilot study as well. This means whether the respondents can actually answer the question even if the question is absolutely clear. Designing a standardized questionnaire is a difficult task. Converse and Presser (1986) present a number of possible mistakes and interpretation problems associated with standardized questionnaires. Another important step in a survey study is to draw a sample from the whole study population. Sampling error is a severe type of error since the aim of a survey is to calculate estimates that are valid for the whole study population. Thus an adequate sampling procedure has to be chosen. Another practical problem that can be encountered is that not all potential participants are listed in the sampling frame from which the sample is drawn. A considerable amount of time has to be invested in order to cover the whole study population in the sampling frame. Surveys can only be implemented when an up-to-date list of beneficiaries and their contact addresses is available. Kalton (1983) provides a thorough overview of survey sampling. Ruegg and Feller (2003) provide a detailed description of the different steps involved in a more thorough way. Finally, an econometric model can be specified in order to measure a theoretically defined relationship between government invention and the goal variable. Statistical or econometric data analysis can be applied in order to analyse the responses of the survey.

Scope and limits

There are advantages and disadvantages associated with the various methods of collecting data for statistical analysis. According to Calidoni-Lundberg (2006), surveys have a number of advantages. One advantage of the survey method is that it provides a relatively quick way to obtain qualitative and quantitative information about programme effectiveness that is easily understood by a broad audience. Surveys are an efficient way of collecting information from a large number of respondents due to the fact that large samples are possible, although the extent of the sample depends on the research budget. Moreover, statistical techniques can be used to determine validity, reliability, and statistical significance. Because surveys are standardised in most cases they are relatively free from several types of errors. However even though the survey method represents the most commonly used instrument for data collection it nevertheless suffers from several limitations. According to Ruegg and Feller (2003) every method has its pro and cons, but the application of a mix-mode approach may offer further advantages.

Some of the disadvantages are listed in the following. Surveys are not suitable for the collection of complex data. They depend to a considerable extent on the potential respondents' motivation, honesty, memory and ability to respond; it can be difficult to create random samples and respondents are frequently self-selected. In addition, structured surveys, particularly those with closed ended questions, may have low validity when researching affective variables. As stated above the response rate is the single most important indicator of how much confidence can be placed in the results of a survey. Therefore, a low response rate can be devastating to the reliability of a study.

A further limitation is that the responses on which descriptive statistics are based are often subjective in nature. Respondents may not always tell the truth. They may have faulty recall. Or they may wish to promote a particular point of view. Hence, results may be biased. In particular, survey respondents from firms may have a bias towards the internal activities of their own companies and have a rather limited knowledge of their sectors and technologies. Furthermore, a single survey can establish whether or not a relationship exists between two variables but is not sufficient to determine the direction of causality. Finally, conducting a survey is not a trivial undertaking. Surveys require careful research and planning, are labour intensive, and can take weeks to implement and analyse.

B.2.6 Econometric modelling

Introduction

Econometric models are sometimes used for prospective analyses which mean that the value of key effects of an intervention is empirically estimated over a certain period of time, in the future. Another issue is to evaluate the effect of some theoretically assumed influences and aspects of a given point in time. In order to evaluate economic relationships, econometric methods apply mathematical models to structure the relationships. Furthermore, statistical methods are applied to analyse economic data in order to estimate model parameters and to enable an interpretation of the results. Econometric methods are specifications of structured models such as Ordinary Least Squares and the method of Maximum-Likelihood. Examples for Maximum-Likelihood are Probits, Logits and Tobits. Ordinary Least Squares is the standard linear regression procedure. It attempts to minimise the sum of the squares of the ordinate differences between points generated by an estimated function and corresponding points in the data. According to Gujarati (2003) the method of Maximum-Likelihood is a method of point estimation with some stronger theoretical properties than the method of Ordinary Least Squares. It attempts to maximise the probability that an estimated function satisfies the corresponding points in the data. Logit and Probit are procedures for the multivariate analysis of binary dependent variables. The influences on such variables cannot be examined with the procedure of the linear regression analysis due to the fact that substantial conditions for application are not offered by inference-statistical methods. Furthermore, a linear regression model can lead to inadmissible forecasts on the basis of such variables. The Probit function is a popular specification of a generalised linear model, using the probit link function. The dependent variable is a dummy binary variable which can only take the values one or zero and is expressed as a linear function of one or more independent variables. Because the response is a series of dichotomous results the likelihood of the outcomes is linked to some regressors by a linear model. The Logit function is the inverse of the logistic function, also known as sigmoid function. The statistical model set-up is the same as in the probit case, thus the values of the dependent variable are also constrained to lie within the 0 to 1 probability limits. The only difference between the two models is the different link function. The Tobit model, also known as the censored normal regression model, is an econometric model which is commonly applied in cases when the dependent variable is censored because values of the variable below zero are not observed. Gujarati (2003, p. 616) defines a censored sample as a sample in which information on the regressand is available only for some observations. Commonly, these methods are used to analyse correlational relationships usually with the hope of determining causation. According to Ruegg and Feller (2003) econometrics contains model building, estimation, hypothesis formation and testing as well as extensive data analysis. The method is utilised in a broad domain and applies many techniques from mathematics and statistics. Econometric models can be applied to create different scenarios, for instance, one scenario in which the programme was attended and an alternative scenario in which participation is absent. Thus, it is possible to assess the counterfactual situation and to estimate the likely net effects of programme participation. Econometric modelling is possible in both ex-ante and ex-post evaluations. It is characterised by the fact that the results are highly quantitative. In order to evaluate impacts of programmes, the European Commission (2004) introduces three different types of econometric models: productivity measurement, macroeconomic modelling and simulation, and microeconometric modelling.

Productivity measurement

According to Eaton in European Commission (2002), productivity measurement offers an econometric method to determine the impacts of a programme on the basis of an estimation of the production function using ex-post input and output data. Productivity measurement tends to estimate a production function, i.e. the mathematical expression of the technical relationship between inputs and outputs. Ruegg and Feller (2003, pp. 43-44) state that "the production function equation quantifies the output that can be obtained from combinations of inputs, assuming the most efficient available methods of production are used. The production function can be used to estimate the change in output from an additional input or the least-cost combination of productive factors that can be used to produce a given output."

Macroeconomic modelling and simulation

In general, macroeconomic modelling is designed to simulate the operation of a national or international economy and is characterised by the fact that it is used to analyse macroeconomic aggregates such as employment, production, demand, world trade, etc. Jansen (2004, p.1) states that "macroeconometric modelling aims at explaining the empirical behaviour of an actual economic system". Macroeconomic models are used to generate economic forecasts, to evaluate potential outcomes of policies and external events and to produce "what if" scenarios, predicting future economic developments under alternative scenarios. Within the domain of macroeconomic modelling there are many different types of models. Capron and Cincera in European Commission (2002, p. 83) introduce two broad types of models in order to establish the impact of programmes:

Neo-Keynesian macroeconomic models: describe macroeconomic modelling as "[…] a set of structural equations based on the economic theory and are designed to explain the economy or some parts of the economy".

Computable general equilibrium models describe this to be " […] an integrated system of equations derived from microeconomic theory of the behaviour of all economic agents and built on intertemporal market clearing behaviour, whose simultaneous solution uses a numerical database to determine values of the endogenous variables […]".

According to the EVIMP-Consortium (2002) the effects of a programme cannot be derived clearly from macroeconomic aggregates. For this reason the usage of macroeconomic modelling is a controversial issue at least in the short run.

Microeconometric models

Microeconometric models are based upon individual-level data and analyse the economic behaviour of individuals or firms. A broader definition would also include grouped data. Usually regression methods are applied to cross-section or panel data. Following the EVIMP-Consortium (2002) micro data may generate more enlightening information compared to macroeconomic data. The practical application of micro-econometric models is increasing. One major reason is the improved availability of large-scale micro-data on the level of firms through the Community Innovation Survey (CIS).

Examples of application and good practice

Econometric methods are rarely applied in evaluations of R&D programmes. One reason behind this might be the absence of quantitative data. However, econometric methods are increasingly used in the economics of innovation and technology to explain the innovative behaviour of firms. The most important data source in this context is the Community Innovation Survey (CIS).

Required data and conditions

Econometric modelling presumes the accuracy of the structural relationship on which the model is built. In order to obtain statistically adequate results, econometric estimations demand a large number of observations (or responses). Adequate sampling techniques have to be taken into account. According to Arvanitis and Keilbach in European Commission (2002) the type of data needed depends on the underlying economic model. Microeconometric data are usually at a low level of aggregation. This has a major consequence for the functional forms used to analyse the variables of interest. In many cases linear functional forms turn out to be simply inappropriate. More fundamentally, disaggregation brings to the forefront the heterogeneity of individuals, firms, and organisations that should be properly controlled if one wants to make valid inferences about the underlying relationships. Although aggregation is not entirely absent in micro data the level of aggregation is usually lower than it is common in macro analyses. The process of aggregation leads to smoothing with many of the movements in opposite directions cancelling in the course of summation. The aggregated variables often show smoother behaviour than their components and the relationships between the aggregates frequently show greater smoothness than the components. Usually individual- and firm-level data cover a huge range of variation, both in the cross-section and time-series dimensions. As Pudney (1989) has observed, micro data exhibit holes, kinks and corners. The holes correspond to non-participation in the activity of interest; kinks correspond to the switching behaviour and corners correspond to the incidence of non-consumption or non-participation at specific points of time. This means discreteness and nonlinearity of response are intrinsic to microeconometrics. Nonetheless, it is often possible to derive a simpler (for example, linear) estimation equation from a more complex structural model.

Steps for implementation

According to Gujarati (2003, p.3) traditional econometric methodology proceeds with the following steps:

- Statement of theory or hypothesis
- Specification of the mathematical model of the theory
- Specification of the statistical or econometric model
- Obtaining the data
- Estimation of the parameters of the econometric model
- Hypothesis testing
- Forecasting or prediction
- Using the model for control or policy purposes

With reference to Arvantis and Keilbach in European Commission (2002) the first step in econometric modelling is the definition of the goal variables. Furthermore, an econometric model has to be specified. The building block of the econometric model is the economic (or evaluation) model that models the structural relationship between dependent and independent variables. The next step is the search for appropriate data or the collection of original data. After the econometric method has been chosen, the econometric estimations can be conducted and the results interpreted.

Scope and limits

One advantage of econometric methods is that they can be conducive to a comprehension of the relationships between dependent and independent variables using complex and imperfect data. According to Ruegg and Feller (2003) econometric methods can be applied in order to produce quantitative results with extensive parameters and more importantly, can be used to illustrate cause-and-effect relationships. Thus, their strength is based on thefact that they can provide more statistically defensible evidence about expected cause-effect relationships than most other evaluation methods. With reference to Ruegg and Feller (2003) the disadvantage of these methods is that both the approaches and results may be difficult for the non-specialist to understand, replicate, and communicate. In addition, econometric methods are data-intensive. According to Arvanitis and Keilbach in the European Commission (2002), the most serious shortcomings of the use of econometric methods are related to data limitations. Therefore, the activity involved in data collection and adjustment is time consuming and expensive. The problems related to correctly specifying the empirical model and jointly testing the assumed causal relationships are further sources of difficulty. Econometric models are based upon simplifications and assumptions. The European Commission (2004, p. 88) states that "the capacity of a model to produce meaningful estimates of future situations depends firstly on the accuracy of the assumed causal relationships on which the model is built, which by necessity represent a simplified version of a complex reality, and secondly on the stability of these relationships over time." In particular, assumptions about the probability distribution of the underlying data and the subsequent model exhibit some problems. If these assumptions are not met, the statistical significance of the results is in question. For that reason, econometric methods can also involve numerous decisions and assumptions that significantly affect findings. Besides, following Ruegg and Feller (2003, p. 44) "not all effects can be captured in these highly quantitative methods, which are imperfect and variable in how well they capture relationships between changing technical knowledge and economic and social phenomena."

C APPENDIX 3: PROGRAMME DATABASE

C.1 Objective

One of the main objectives of the ImpLore study was to identify and list all initiatives and research programmes with significant impact on innovation. The programme database was designed in order to cover the variables necessary to assess design, management and evaluation features of all the R&D programmes with significant impact on innovation.

C.2 Methodology

The database of R&D programmes was designed to include data on:

- A wide range of variables describing the design and management of R&D programmes;
- Variables describing the evaluation and impact assessment, and the methodologies associated with individual programmes;
- Variables describing the innovation impacts associated with individual programmes;

A list of design features that describes the variables included in the database was developed in close collaboration with all consortium members. It was revised after a number of tests and discussions. The database covers 431 R&D programmes in the EU and a selected number of R&D programmes in third countries. It includes the most relevant public R&D programmes that have had an impact on innovation. R&D programmes that are included in the database are defined by the following characteristics: They have a limited duration, a well-defined budget, a pre-defined target group, and pre-defined target activities. This means that block grants to universities, permanent institutional subsidies, general R&D subsidies, and Structural Funds and other regional programmes are not included. The focus is on R&D programmes and initiatives on the federal level that predominantly foster R&D. The study mostly comprises current R&D programmes, but also includes some programmes that were completed within the last five years. The data contained in the database was collected by different means. On the level of ministries and programme owners/programme management agencies, there is public information available about the rules and regulations governing the R&D programmes. Nevertheless, a considerable amount of original data had to be collected by different methods since not all types of information are publicly available. Additional data collection methods applied in order to fill the gaps in the database were personal interviews and telephone interviews with programme managers.

C.3 List of Design Features

The list of design features was used to collect data on R&D programmes and initiatives.

A History and Genesis of the programme

A.1 How has the programme emerged?

- Evaluation
- International policy learning
- User-influence
- Other

A.2 Is the current programme derived from a previous programme (immediate forerunner)?

- Yes
- No

A.3 If yes: name the programme

B General design of R&D programme

B.1 What is the rationale of the programme (problem definition/motivation)?

B.2 Who is/was involved in selecting the priorities of the R&D programme?

- Government ministry
- Business representatives
- Research council
- Programme management agency
- Representatives of civil society
- Other

B.3 What is the duration of the programme?

B.4 Which ministry/agency is responsible for the programme?

- Economic/trade/industry ministry
- Science and education ministry
- Social ministry
- Other ministry
- Ministerial agency
- Other

B.5 What is the geographical focus of the R&D programme?

- Regional
- National
- International
- Transnational
- Other

B.6 What is the aim/objective of the R&D programme?

- Support industrial innovation
- Develop knowledge-based industries
- Improve scientific knowledge
- Exploit scientific knowledge
- Adress social/environmental challenges
- Increase internationalisation
- Develop industry/science relations
- Other

B.7 Does the programme have a technology focus?

- Yes
- No
- Don't know

B.8 Are specific innovation "targets" and objectives specified in the programme?

- Yes
- No
- Don't know

B.9 Is the generation of IPR (patents) an important project target?

- Yes
- No
- Don't know

B.10 Is the commercial exploitation of the results a mandatory target (e.g., mandatory commercialisation plans)?

- Yes
- No
- Don't know

B.11 What are the eligibility criteria?

- Public research organisations (e.g., universities, public research institutes)
- Private research organisations (e.g., An-Institutes)
- SMEs
- Local administration
- Applicants with a certain track record (e.g., previous experience)
- Spin-offs
- Other

B.12 Is collaboration mandatory?

- Yes
- No
- Don't know

B.13 What types of collaboration are encouraged?

- Science/industry
- Industry/industry
- Science/science
- Science/administration
- Collaboration with SMEs
- None
- Other

B.14 Is the programme open to participants from other countries?

- EU-countries
- Non-EU-countries
- No

B.15 Do foreign participants receive money?

- Yes
- No
- Don't know

B.16 What types of projects are funded?

- Basic research
- Applied research
- Experimental development
  Industrial design
  Knowledge- and technology transfer
- Dissemination
- Innovation

B.17 Are there any accompanying measures or links to other programmes?

- Yes
- No

- Don't know

B.18 If yes, please name those programmes/measures.

C Funding issues

C.1 How large is the maximum public budget for each project?

C.2 How large is the minimum public budget for each project?

C.3 How large is the maximum public share by type of beneficiary?

- Type of beneficiary:
  companies
  universities
  Other

C.4 How large is the total budget of the R&D programme?

C.5 For what period is funding provided?

C.6 Minimum range (min duration)

C.7 Maximum range (max duration)

C.8 Is private co-funding required?

- Yes
- No
- Don't know

C.9 What is the average private funding level?

C.10 What is the minimum level of private funding?

C.11 What is the average number of participants per project?

C.12 How is payment provided?

- Up-front
- Time-dependent
- Milestone dependent
- Expenditure reimbursement
- Other

D Selection criteria

D.1 Please provide a list of selection criteria! (E.g., technological newness, scientific record, exploitation plan, collaboration, management quality (meeting criteria such as relevance or modalities), egalitarian/equal dispersion of funds, transnationality, high risk of the project).

D.2 To what extend do the selection criteria favour R&D projects that have the propensity to impact on innovation?

- Innovation criteria dominate
- Quite a lot
- Not very much
- Not at all

E Project management

E.1 Who manages the programme?

- Ministry staff
- Managing agency
- Business representatives
- Private firm
- Academic institution
- Foundation/research council
- Other

E.2 What types of calls are used?

- Open calls
- Subsequent calls
- Restricted calls
- Other

E.3 How are applicants selected?

- One stage review
- Two stage review
- Multiple stages
- Other

F Project selection and programme execution

F.1 Who selects the projects?

- Internal staff (regarding project management)
- Expert panel with business representatives
- Expert panel with academics
- Mixed expert panels (with academics and business representatives)
- International external proposal evaluators
- Internal staff in combination with external panel
- Other

F.2 How are IPR issues regulated in the funding contracts?

- Funder owns IPR
- Firm/organisation (beneficiaries)
- Inventor owns IPR
- Other

F.3 Are the beneficiaries obliged to disseminate/disclose the project results to the public?

- Obliged to disseminate
- Required to disclose
- Obliged to disclose on request
- No

F.4 What is the selection rate (percentage of proposals that receive funding)?

F.5 What types of collaboration predominantly received funding?

- Science/industry
- Industry/industry
- Science/science
- Science/administration
  Collaboration with SMEs
  None
- Other

F.6 What types of projects predominantly received funding?

- Basic research
- Applied research
- Experimental development
  Industrial design
  Knowledge- and technology transfer
- Dissemination
- Innovation

G Monitoring of the projects

G.1 Is the progress of the projects monitored?

- Yes
- No
- Don't know

G.2 Who monitors the projects?

- Ministry staff
- Managing agency
- Subcontractor
- Sponsor's representatives
- Business representatives
- Academics
- User committee
- Other

G.3 What is the function of monitoring?

G.4 On what level is monitoring accomplished?

- National
- International

G.5 How are the funding contracts managed/enforced?

- No accountability is enforced
- Obligatory accountability
- Results of the project assessments are publicly available
- Results of project assessment available only for parties involved
- Legal measures are envisaged in case of maladministration, other abuses
- No legal consequences are foreseen
- Other

G.6 What indicators have to be reported?

- Number of people involved (working days, hours)
- Money spent
- Output
- Publications
- Patents
- New companies set up
- Compliance with objective set
- Profitability
- Return on subsidy (investment)
- Other

H Programme management/evaluation

H.1 Is the whole programme reviewed and assessed regularly?

- Yes
- No
- Don't know

H.2 What type of evaluation is applied?

- Ex ante
- Ex post
- Interim
- Other

H.3 Who evaluates the R&D programme?

- Government/ministry
- Programme management agency
- External evaluators
- Other

H.4 Who defines the evaluation criteria?

- Programme management
- Evaluators
- Expert panel
- Other

H.5 What kind of methodologies are involved?

- Qualitative interviews with management, beneficiaries, stakeholders
- Case studies
- Survey of beneficiaries
- Control-group approaches
- Economic modelling
- Analysis of monitoring data
- Other

H.6 What type of evaluation is conducted?

- Evaluation of efficiency (organisational aspects)
- Evaluation of effectiveness (impact, additionality)
- Other

H.7 What is the purpose of evaluation?

- Improving programme management
- Re-design of eligibility/selection criteria
- Re-design of objectives/programme layout/concept
- Assessing impacts/effectiveness
- Other

I Impacts/output

I.1 What kind of benefit/impact can be expected from the R&D programme? Distinguish between short-term/medium-term/long-term impacts! Open answer

J Openness of programmes

J.1 Does the programme have a sufficient openness by design to address the European Research Area?

- Yes
- No
- Don't know

J.2 Is the involvement of non-residents mandatory?

- Yes
- No
- Don't know

J.3 Which of the statements best describes the programme policy for involvement of non-resident researchers?

- Allowed only when there is no national capability
- Allowed when there is a clear benefit to the project
- Actively encouraged

J.4 The share of information between projects related to a specific programme is ...

- Mandatory
- actively encouraged
- intended
- not foreseen

J.5 The share of information between programmes with similar targets is ...

- Mandatory
- actively encouraged
- intended
- not foreseen

J.6 Is there a link to other science communities for the programme?

- Yes
- No

- Don't know

J.7 Does the programme and its projects have to refer to other international sources?

- Yes
- No
- Don't know

J.8 Is a presentation of the programme to other science communities...

- Mandatory
- actively encouraged
- intended
- not foreseen

J.9 Is a presentation of the project results to other science communities ...

- Mandatory
- actively encouraged
- intended
- not foreseen

J.10 Are the programme specifications available in different languages?

- Yes
- No
- Don't know

J.11 Are project results available in different languages?

- Yes
- No
- Don't know

J.12 Have you detected changes in programme design towards more openness in the past?

- Yes
- No
- Don't know

J.13 Are you aware of incentives regarding more transnational activities within programmes?

- Yes
- No
- Don't know

D APPENDIX 4: COUNTRY REPORTS

D.1 Objective

The aim of the country reports was to gather information and develop hypotheses on wider factors that influence the design, management and evaluation of the programmes in that country. The country report summarises the national characteristics and trends that have an impact on R&D programme innovation. This makes it easier to situate the R&D programmes in a broader political and institutional context.

D.2 Methodology

Country experts were asked to collect information on the contextual factors that influence the design of R&D programmes. This involves an investigation of characteristic programme design, management and evaluation features which the country experts believe to have had an impact on innovation, the barriers to this impact and the impact enablers.

First, the experts produced informal country reports that enabled a horizontal analysis of almost 150 factors that have, in their expert opinion, some influence on the impact of public R&D on innovation. Horizontal analysis of these factors allowed us to prioritise the most prevalent generic strategies and also the barriers that have an inhibiting effect.

In the 2nd round the country experts were asked to rank a shortlisted version of the most common generic strategies and barriers in order of their relative prevalence in that country and to what extent they had an influence on the impact on innovation of R&D programmes. This allowed us to carry out a secondary analysis to confirm our hypothesis that good practice R&D strategies to maximise the impact on innovation are very dependent on the situation in a particular country. It also highlighted five different types of countries within the EU where there may be scope for mutual learning and sharing of good practice. Country reports were drafted for 36 countries (EU Member States plus Australia, Israel, Iceland, New Zealand, Canada, USA, Japan, Switzerland, Norway).

D.3 Template for the Country Report

The following template was used for the qualitative assessment of the country context of R&D programmes and initiatives.

D.3.1 Method of data collection

- Please describe the data collection method here. This should contain details about the selection procedure (e.g. regarding certain family-programmes or accompanying initiatives), data sources (e.g., Trend Chart) and the method (e.g., desk research, personal interviews, telephone interviews, focus groups).

D.3.2 General trends along the research policymaking cycle regarding the impact of research programmes on innovation

- Please describe general trends that are relevant for the impact of design and management features of R&D programmes on innovation.
- Please differentiate between the programme level and the broader policy level.

D.3.3 Analysis of the characteristics of research programmes

- Describe the characteristic design features of R&D programmes in your country.
- Describe the characteristic management features of R&D programmes in your country.
- Describe the characteristic evaluation features of R&D programmes in your country.

D.3.4 Public research and innovation

- Please describe the (expected) impacts of clusters or bundles of R&D programmes in your country.
- Which methods and indicators are most often used in your country for ex-ante evaluation of output/impact and for ex-post assessments of impacts on innovation?

D.3.5 Characteristics of national innovation systems that act as barriers or accelerators for generating impact

- Please describe those factors in the national innovation system that act as barriers or accelerators with regard to innovation impact. Please apply a broad perspective of the national innovation system.

D.3.6 Policy learning

- Identify programmes that can serve as good practice examples
- Which tools and methodologies are used in your country for identifying good practice and benchmarking programmes as well for facilitating policy-learning?
- How do the stakeholders of the programmes in your country meet and learn from each other, and exchange best practices

D.3.7 International openness

- Please comment on the results from the database. Does it correspond to policy statements at national level?

E APPENDIX 5: SURVEY OF PROGRAMME MANAGERS

E.1 Objective

The strategy adopted in the InnoImpact study (Lot 1) involved a self-assessment questionnaire targeted at participants in the EU RTD Fifth Framework Programme (FP5). The option of targeting participants in national programmes was not feasible in the ImpLore study, largely on the grounds of cost, scale and availability of participation data (and also the ability to derive data for non-participants). However, it is feasible to target the programme managers of multiple programmes in order to gain an overview of their assessments of innovation impacts and the factors affecting these impacts. Thus, the objective of the survey of programme managers was to assess the impact of R&D programmes on innovation and to identify the design, management and evaluation features of R&D programmes that are especially relevant with regard to innovation impacts. A further objective was to identify the strategies that are used to improve innovation impacts.

E.2 Methodology

A questionnaire was sent to the responsible managers of all programmes in the programme database for whom there was relevant and adequate data on design and management variables. Detailed responses are available for 173 R&D programmes. The questionnaire comprised three parts. The first part focused on the innovation impacts of individual programmes. It exploited the innovation impact categories utilised in the InnoImpact study[15] and explored the range and scale of these impacts. The second part of the questionnaire tackled the relationship between design and management variables and innovation impact. This part of the questionnaire focused on programme managers' perceptions of specific relationships between selected design and management variables and different types of impacts. In essence, the questions in this section tested hypotheses derived from initial inspection of the data contained in the database and material contained in the general literature on the impact of R&D programmes on innovation. The final part of the questionnaire asked specific questions about the strategies adopted by individual programme managers or administrations to both assess and improve innovation impacts. These included both strategies deployed during the course of individual programmes and the strategies used by administrations to select and design programmes with the potential to have high innovation targets. Results from this survey were linked to the information about programme characteristics.

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[15] This is largely based upon work conducted over the past twenty years by some of the members of the ImpLore consortium.

E.3 Questionnaire for the Survey of Programme Managers

INNOVATION IMPACTS

			Very low impact	Low impact	Moderate impact	High impact	Very high impact	Don't know	Not applica-ble
1		***Please indicate the areas in which your programme is having, or has had, its greatest impacts.***							
A	*1*	*Direct impacts on academic participants*							
	2	Direct impacts on industrial participants							
	3	Direct impacts on other types of participant							
	4	Indirect impacts on ***non-participants*** (e.g. as a consequence of the activities of participants)							
B	*1*	*Impacts on limited range of scientific and technological disciplines and domains*							
	2	Impacts on a broad range of scientific and technological disciplines and domains							
	3	Impacts on interdisciplinary R&D and innovation activities							
	4	Impacts on a limited range of industrial sectors							
	5	Impacts on a broad range of industrial sectors							
C	1	Direct impacts on the knowledge capabilities and research performance of participants							
	2	Direct impacts on the ability of participants to interact and network							
	3	Direct impacts on commercial exploitation and the innovation performance of participants (via new products, new processes, enhanced market sales etc.)							
	4	Indirect impacts on commercial exploitation and the innovation performance of participants (via the accumulated impact of enhanced research performance)							
	5	Indirect impact on commercial exploitation and the innovation performance of ***non-participants*** (e.g. due to the activities of participants and the diffusion of innovations)							
	6	Direct and indirect impacts in spheres such as standards formulation, regulation and policy development							
D	*1*	*The production of 'tangible' knowledge outputs e.g. publications, PhDs, new tools and techniques etc.*							
	2	The production of 'intangible' knowledge outputs e.g. enhanced knowledge bases, improved skills and capabilities etc.							
	3	Patents, licences, copyrights and other IPR							
	4	New or improved products							
	5	New or improved processes							

		Very low impact	Low impact	Moderate impact	High impact	Very high impact	Don't know	Not applica-ble
6	New or improved services							
7	New or improved standards, regulations or policies							
8	New start-up companies or spin-offs							
9	Improved innovation performance amongst participants							
10	Improved innovation performance of the economy at large							
11	Improved turnover, profitability and market sales of participants							
12	Improved turnover, profitability and market sales within the economy at large							
13	Enhanced competitiveness of participants							
14	Enhanced competitiveness of the economy at large							

F Other impacts (please specify)

1								
2								
3								
4								
5								

THE RELATIONSHIP BETWEEN DESIGN AND MANAGEMENT VARIABLES AND INNOVATION IMPACTS

2 ***Please indicate those aspects of the design and management of your programme which are having, or which had, the greatest effect on the overall innovation impact of your programme.***

A *History and Genesis of the Programme*

1	The existence of a strong innovation-related rationale for the programme							
2	Prior experience in the design and management of previous programmes (e.g. forerunners of the existing programme)							
3	A deliberate strategy to involve users in the design of the programme							
4	A deliberate strategy to involve users in the programme itself							

		Very low impact	*Low impact*	*Moderate impact*	*High impact*	*Very high impact*	*Don't know*	*Not applicable*
B	*General Design of the Programme*							
1	A deliberate attempt to support industrial innovation							
2	A deliberate focus on innovation-related targets							
3	A deliberate focus on projects nearer the innovation end of the spectrum rather than the basic research end							
4	The involvement of industry or trade ministries or agencies in the design of the programme							
5	The involvement of business representatives in the design of the programme							
6	Eligibility criteria favouring organisations with good innovation track records							
7	A deliberate focus on the production of IPR, patents etc.							
8	IPR regimes favouring industrial participants							
9	A mandatory requirement to produce commercialisation plans							
10	A mandatory requirement for projects to be collaborative							
11	A deliberate focus on science/industry collaborations							
12	A deliberate focus on industry/industry collaborations							
13	The choice of a specific technology focus							
14	A focus on R&D and innovation actors in a specific region							
15	A focus on R&D and innovation actors in a specific industry sector							
C	*Selection Criteria*							
1	Selection criteria favouring scientific excellence							
2	Selection criteria favouring high risk projects							
3	Selection criteria favouring projects with high innovation potential							
4	The involvement of industrial representatives on selection panels							
D	*Programme Dimensions*							
1	The duration of the programme							
2	The average duration of projects in your portfolio							
3	The overall size of your programme's budget							
4	The average number of participants per project							

		Very low impact	Low impact	Moderate impact	High impact	Very high impact	Don't know	Not applica-ble
E	*Programme Management and Operation*							
1	Programme management located in a 'science/research' ministry							
2	Programme management located in an 'industry/innovation' ministry							
3	Programme management located in an agency							
4	Programme management located in a research council							
5	Programme management handled by other external bodies							
6	The existence of private co-funding (provided either by participants themselves or by other sources)							
7	The openness of the programme to participants from other countries							
8	The sharing of information between projects within the programme							
9	The sharing of information with projects in other programmes							
10	Limited obligations on participants to disseminate project results							
11	Mandatory obligations on participants to disseminate project results							
12	The existence of accompanying measures or links to other initiatives supporting exploitation and commercialisation							
F	*Programme Monitoring and Evaluation*							
1	The implementation of comprehensive project monitoring arrangements							
2	The use of innovation-oriented indicators to monitor project progress							
3	The implementation of comprehensive programme evaluation arrangements							
4	Evaluations specifically focusing on impact assessment, particularly innovation impact assessment							
G	*Other Design and Management Variables Affecting Innovation Impacts (please specify)*							
1								
2								
3								
4								
5								

STRATEGIES TO IMPROVE IMPACTS

		Very low impact	Low impact	Moderate impact	High impact	Very high impact	Don't know	Not applica-ble
3 A	*Please indicate the importance attached to any of the following strategies designed to improve the innovation impacts of your programme or future programmes*							
1	The use of strategic intelligence tools and techniques[1] to identify technical and market areas with high innovation potential							
2	The use of strategic intelligence tools and techniques to identify potential participants with good innovation track records (e.g. a history of patenting)							
3	The use of benchmarking approaches to identify policy practices in other countries that have led to high innovation impacts							
4	The use of consultation exercises and workshops to discuss stakeholder requirements and innovation policy priorities							
5	The use of monitoring and evaluation results to identify programme design aspects likely to lead to high innovation impacts							
6	The use of monitoring and evaluation results to identify programme management aspects likely to lead to high innovation impacts							

[1] Strategic intelligence tools include foresight exercises, technology roadmaps, market and user surveys etc.

B *Please use the box below to describe interesting ways of improving the innovation impact of R&D programmes which you have either tried or would recommend trying in future.*

F APPENDIX 6: FOCUS GROUPS

F.1 Objective

Focus groups were conducted in order to collect data about the perceived innovation impacts of public R&D programmes.

The primary aim of the focus groups, which were conducted in a number of different countries across the EU, was to discuss hypotheses linking design, management and evaluation features of public R&D programmes to different innovation impacts. A secondary aim was to improve the ways in which innovation-related impacts are monitored and evaluated and to identify R&D programmes that can serve as good practice.

This appendix contains the guide to focus groups that was distributed for preparation to all moderators of focus group sessions along with the focus group interview guide. Furthermore, the briefing paper that was sent to all participants of the focus group sessions is shown.

F.2 Methodology

Guidelines for the focus groups were developed that present the methodological approach. The guidelines contain a review of the literature on focus groups, a briefing paper that was distributed to the participants in advance and an interview guide used during the focus groups. Stakeholders from public policy makers, programme management agencies, industry and experts with regard to evaluation of public R&D programmes were invited to the focus group sessions.

The focus group sessions were structured in the following way:

- Session 1: the participants were asked to sort out the design and management criteria of research programmes that have had the highest impact on innovation.
- Session 2: the participants were asked to discuss how the impact of research programmes is assessed in their country. In particular, what were the most important management, evaluation and monitoring techniques in order to achieve a high innovation impact with a programme?

Between six and ten stakeholders were brought together in each focus group. Each focus group was moderated by one member of the ImpLore consortium. During the focus group sessions, notes were taken by at least one assistant and the discussions were taped in order to ease the qualitative analysis of the focus group material. Focus groups were conducted in Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Poland, Sweden and the United Kingdom. Two focus groups each were conducted in Austria, Germany and Greece.

After the focus groups were conducted, drafts were written, in most cases by the moderators of the focus groups, summarising the content of the focus group sessions. These drafts were circulated among the ImpLore consortium in order to develop common categories that allowed for meaningful comparison between the countries in which focus groups were conducted.

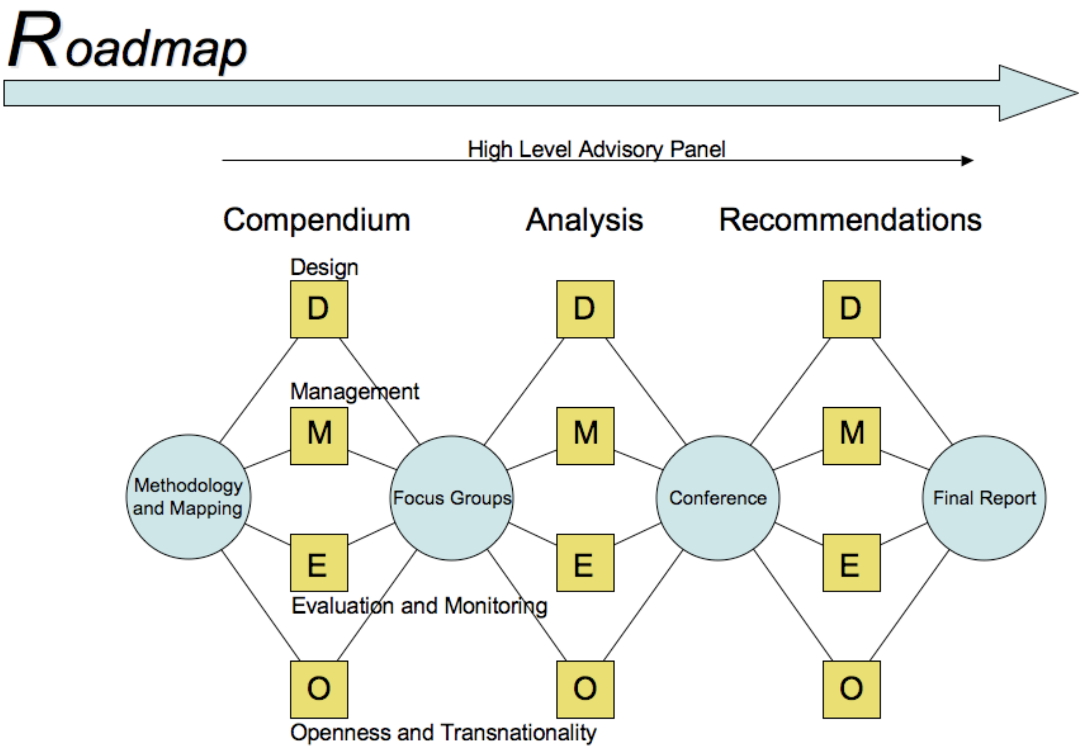
F.3 A Guide to Focus Groups

The following text was distributed to the moderators of each focus group session in order to facilitate a common understanding of the focus group approach and to guarantee a uniform application of the focus group approach in each country.

Introduction

Focus groups have a central role in the ImpLore project as depicted in the roadmap below (Figure 31).

Figure 31: Roadmap of the ImpLore project



Source: ImpLore

The central aim of the study is to assess the impact of the design, management, evaluation and openness features of public R&D programmes on innovation. It is difficult to assess the specific impact of specific R&D programmes. Thus, an alternative approach is to use focus groups for this endeavour. Focus groups are "a research technique that collects data through group interaction on a topic determined by the researcher" (Morgan 1996, p. 130). We invite people that possess knowledge about the impact of R&D programmes: policy makers and administrators that have experience with the design and management of R&D programmes, consultants that have experience with regard to evaluation of R&D

programmes, academic experts that have experience in the field of evaluation and analysis of R&D programmes. The focus groups will consist of 6 to 10 experts who will discuss the topics of the ImpLore project. The sessions will be recorded and the transcriptions will be analysed in a qualitative way.

In order to provide guidance for conducting the focus group, this paper provides a literature review on focus groups to inform the reader about the status quo of this method.

Focus groups in the literature

As already mentioned, a focus group can be defined as "a research technique that collects data through group interaction on a topic determined by the researcher" (Morgan 1996, p. 130). A focus group is an instrument for qualitative research. A group of individuals has been brought together to discus a particular topic, a product, service, concept or an idea (Marshall & Rossmann, 1999). Questions are asked in an interactive group setting where the group members are free to talk with the other participants also called the synergy of the group (Kitzinger, 1994). The focus group makes it possible for the researchers to observe transactions between and among the participants, how they respond and react to each other (Goldman, 1962).

Focus group discussions in the context of market research enable the producers and sellers to understand the thinking of consumers (Krueger, 1988). "First developed for market researchers to determine the present or potential impact of a product or service, focus groups also help administrators and developers gain information about programs, assess the effectiveness of healthcare and family-planning projects, design political campaigns, and evaluate graduate programs and research efforts, among other data-collection tasks" (Quible, 1998). Some areas where focus groups were used are: public relations (Sink, 1991), political campaigns (Lydecker, 1986), research efforts (Morgan, 1988) and training evaluation (O'Donell, 1988).

Calder (1977) distinguishes focus groups by the type of knowledge they generate, where knowledge can be classified in everyday and scientific knowledge. "Everyday knowledge stems from the terms and language people use to give meaning to their everyday world, whereas scientific knowledge involves the use of numerical measurement to test constructs and hypotheses". These two types of knowledge are associated with qualitative and quantitative research respectively and Calder argues that focus groups can be used to gather both types of data" (McLafferty, 2004). On the other hand Basch (1987) regards focus groups only as a qualitative research method.

Jovchelovitch (2001) describes a focus group as a kind of "thinking miniature society". A focus group is a dynamic context that enables the participants to "negotiate" about differences in opinion. The conversation and discussion in a focus group does not only consist of individual contributions but also the wider societal context. In order to get a broad picture about the opinions and implicit assumptions of the participants it is not only important look at the content of the discussion but also the way in which the discussion proceeds, i.e. the way the words are said. Related to this issue is the fact that focus groups enable the researcher to study the process of how meaning and opinions are shaped collectively. The researcher gets an impression about how opinions are formulated and articulated, defended and even changed during the discussion. This is in line with Albrecht who states that "opinions about a variety of issues are generally determined not by individual information gathering and deliberation but through communication with others" (Albrecht 1993, p. 54). Radley and Billig (1996, p. 223) call this process of thinking a "socially shared activity" which can be studied in the social context of a focus group. A big advantage of focus groups is to give the researcher the possibility to study how opinions are constructed collectively. Focus groups are also full of surprises. The moderator maintains a passive role in order to avoid steering the discussion in any way. Thus the participants have the possibility to provide interesting "stories" and describe their experiences in their own words.

The composition of a focus group

In order to allow for a meaningful discussion the participants should be rather homogenous. An important assumption of focus groups is that the participants are willing to share their views with the other participants and to provide personal information. Thus, the composition of the groups should be homogenous with regard to age and socioeconomic factors. Heterogeneous groups are likely to constrain the discussion. In the case of the ImpLore project it is likely that a number of participants know each other. The "community" with respect to R&D programmes is rather small in each country which increases the likelihood that the group members know each other fairly well. This is likely to ease the discussion.

The opinions concerning the group size vary largely. Some authors advise that groups should consist of 6 to 10 people (Howard et al., 1989) others suggest 4 to 8 people (Kitzinger, 1996). The advantage of a small group is easier manageability by the moderator (Morgan, 1996). The probability of participants' cooperation, interaction and discussion is higher as well in a smaller rather than a bigger group. Merton (Merton et al., 1990) said that a focus group should not be so big "as to be unwieldy or to preclude adequate participation by most members nor should it be so small that it fails to provide substantially greater coverage than that of an interview with one individual". Other authors recommend groups of 12-15 or even up to 20 group members. The number of participants also depends on the personalities of the participants. People who are accustomed to speaking in front of larger groups might not have difficulties in expressing their opinions whereas this might not be the case for those not used to this kind of situation. For people who are not used to speaking in front of groups a smaller group size might be advisable since a large group size would make them reluctant to take part in the discussion. It should also be mentioned that smaller groups provide more "room" to the individual participants. In the course of the ImpLore project, we will probably invite particularly "high-level" people from ministries, project management agencies, consultancies and academic experts. A large focus group would probably constrain the discussion since everybody will want to have a say. Thus a smaller focus groups could be helpful in this context.

Regardless of the size of the focus group, the typical focus group session lasts for about one to one and a half hours (Wibeck 2002).

Another question concerning the research composition is the number of focus groups. Millward (1995) states a maximum number of 10 focus groups, Krueger (1988) advises a number from 3 to 12 focus groups and Stewart & Shamdasani (1990) suggest that there are no general rules concerning the optimal number of focus groups. It really depends on the research goal and the specific circumstances.

A basic difficulty with focus groups is that the results are influenced by the researcher. The design of the focus group study affects the answers of the respondents. In focus groups researchers are not detached observers but always participants. Researchers must take this into account when making their analysis (Walvis, 2003). So the researcher himself is not always the best possible moderator as mentioned by Carey (1994). Although it is important for the success of the focus group interview that the moderator is directly involved in the project because he will be sensitive to the issues, even if his group management skills are not perfectly developed (Millward, 1995).

Basch (1987) describes the role of the moderator to "create a non-threatening supportive climate that encourages all participants to share views; facilitating interaction among members; interjecting probing comments, transitional questions and summaries without interfering too brusquely with the dialogue; covering important topics and questions while relying on judgements to abandon aspects of the outline, noting non-verbal responses".

The participants' comments during the focus group discussions are recorded, usually on either audio- or videotape. Those tapes then become the basis for a report summarizing the comments. Polgar and Thomas (1995) state that video-recording is useful for gathering both non-verbal and verbal data. Similarly, Bottorff (1994) warns that microphones may not pick up all verbal behaviour, nor do they record body movements. Participants may, however refuse to speak in the presence of a camera or may sanitise their views; this may also be true for audio-recording. The real advantage of both video- and audio-recording is that they act as validity checks, in that raw data are available for scrutiny. Furthermore, the provision of recorded data may serve a range of analytical interests. It also allows events to be reviewed as often as is desirable or necessary (Bottorff, 1994). In the ImpLore focus groups, all focus groups should be recorded on tape in order to allow for transcription and analysis afterwards.

With respect to the organisation of focus groups, Axelrod (1975) discussed a number of important points that should be taken into consideration:

- A clearly understood objective. Is the focus group part of an ongoing research project or is it self-contained? Does the research team have a clearly defined subject of study? In the context of the ImpLore project, the topics that should be covered by the focus groups are given and quite clear. The topics are presented in the interview guide for the focus groups.
- Homogeneity within the group. The participants should be homogeneous. In the ImpLore project it is likely that a number of participants know each other which could ease the discussion.
- Good recruiting. Recruiting should insure homogeneity and a sufficient number of qualified participants.
- A relaxed atmosphere. The moderator should insure confidentiality and promote openness.
- A moderator who listens. The moderator must insure that the discussion does not stray too far from the point of interest, yet must not rule out things that may seem unrelated.
- A well prepared moderator. The moderator typically should follow an unstructured interview guide.

- Free-flowing dialogue. The moderator should begin the discussion by inviting an honest and open dialogue and guiding the discussion only when necessary allowing ideas to flow freely. In our focus groups, the moderator starts the discussion by presenting the main results of the study in the respective country.
- Restrained group influence. The moderator should refrain from contributing to the discussion unless necessary.
- Skilled analysis. The data can be analyzed by either a qualitative, or ethnographic summary; or a quantitative systematic coding via content analysis (Morgan, 1988, p. 64). In the ImpLore study, we will focus on qualitative analysis of the focus groups. The discussion will be structured in accordance with broad categories that are related to the interview guide.
- Competent researchers. The research team should be sure that all necessary details are controlled.

Another famous "handbook" for planning, preparing, carrying out and evaluating focus group studies is Krueger & Casey (2000).

Analysis of focus group data

In comparison to other qualitative methods such as observational analysis or one-to-one interviews focus group methods provide a different kind of data. Focus groups provide large amounts of concentrated, well-targeted and pre-filtered data in a short period of time and it is as a result of this a very efficient instrument to get an overview over various opinions. However when compared to interviews the depth of the data is limited (Morgan, 1997).

Analysis of focus group data involves much of the same processes as the analysis of other qualitative data. Thus, a major aim of the analysis is to focus the discussion and identify themes and subcategories (Ritchie & Spencer, 1994). "As with other analyses the main challenge lies in being systematic and thorough" (Barbour, 2001) and moving from the descriptive to the analytical as the researcher attempts to provide an explanation for the patterns identified in the data.

As already mentioned before, applying a focus group approach is based on utilising interaction and synergies. However, these group effects can also overemphasise the data. Sim (1998) warns that "an apparent conformity of view is an emergent property of the group interaction, not a reflection of individual participants' opinions".

With regard to the analysis of focus group data, Krueger (1988) suggested five factors that the focus group researcher has to consider:

- Consider the words. The researcher should consider both the actual words used by participants and the meanings of those words.
- Consider the context. The researcher should examine the context by identifying the "triggering stimulus" for a comment and then interpreting the comment in the context.
- Consider the internal consistency. Participants often change or reverse their positions. The researcher should note when there is a shift in opinion which is relevant to the purpose of study.

- Consider the specificity of responses. Researchers should give more weight to responses that are specific and concrete rather than those that are vague and ambiguous.
- Find the big ideas. Big ideas emerge from "an accumulation of evidence" -the words used, the body language, the intensity of comments- rather than from isolated comments" (Krueger, 1988).

An important keyword in relation to focus group data is cross-validation. This enhances the objectivity and the reliability of the research. Cross-validation is mentioned by Krueger (1988) and Kassarijian (1977) amongst other authors. An important step with regard to cross-validation is when different researchers (including for example, the moderator, researchers who took notes and those who just listened to the recorded discussion) analyse the focus group material independently. In the next step, the comparison of the different analyses can ease the identification of common categories and the drawing of conclusions.

Differences between focus groups and other qualitative methods

The focus group approach is a qualitative method. Another qualitative method which is frequently used in practice is interviews. Fern (1982) compared focus groups to an equivalent number of aggregated responses from individual interviews. He determined that each focus group participant produced only 60% to 70% of the ideas he would have generated in an individual interview. These results clearly argue against the notion that focus groups have a "synergy" that makes them more productive than an equivalent number of individual interviews. Instead the real issue may well be the relative efficiency of the two methods for any given project. For example, Fern's results suggest that two eight-person focus groups would produce as many ideas as 10 individual interviews. The reason why a focus group produces a surplus - more than the sum of separate individual interviews - is the fact that the participants both question each other and explain themselves to each other. As already mentioned, the outcome of focus groups is often a kind of "negotiation" of opinions where the group dynamics play an important role.

Byers and Wilcox (1991) mention a number of advantages and disadvantages of focus groups as shown below.

Advantages of the focus group approach

Based on a review of the literature the method has advantages and disadvantages. First the advantages are highlighted in the following:

- Release of inhibition by participants. A well moderated group encourages full and open expressions of perceptions, experiences, attitudes, etc. To safeguard this the composition of the group should be homogenous.
- Flexibility. A focus group is typically more flexible than an individual interview (Wells, 1974). The moderator "works from a list of topics - listening, thinking, probing, exploring, framing hunches and ideas" (ibid., p. 134). The list of topics should be covered in a kind of rough interview guide.
- Handling contingencies. A focus group is amenable to exploring linkages which go untouched in a statistical survey (Wells, 1974, p. 134). Moreover, it is possible to explore avenues of importance which may arise, other than those listed on a

questionnaire. Thus, focus groups enable the discoverery of rich information on a certain topic.

- Time. Eliciting responses from a number of respondents in a focus group lasting one to two hours is more "time effective" than interviewing the same number individually. However, it should be taken into account that the type of information from focus groups is different from interview data since it is possible that opinions are "negotiated" during the dynamics of the discussion.
- Interpretability of data. Though the data usually contains a wide range of responses (Kover, 1982), the identification of issues and the reasons participants hold positions on issues is usually dependent on careful analysis.
- Provision of basic exploratory information. When little is known about the topic prior to investigation, the focus group may provide a basis for formulating research questions and hypotheses (Zeller, 1987).

However, there are a number of disadvantages of focus groups that have to also be taken into account.

Disadvantages of the Focus Group

- Cost. To conduct a series of focus groups can be quite expensive depending on the moderator fee, facility rental, recording and transcribing, data analysis and interpretation, and participant incentives.
- Subjects' conformity. Social desirability or respondents' motivation to provide socially acceptable responses to conform to group norms is somewhat greater in a group than in the anonymous process of the completion of a survey questionnaire (Crowne & Marlow, 1964). Group pressure and "group think" can constrain the discussion.
- Biased results. An analyst should not generalize from focus group results to the larger population from which the respondents were a sample, and it is well to remember that the respondents are volunteers who may be more extroverted, outgoing, and sociable than the "average" individual.

Focus groups in policy evaluation

Generally, focus group interviews are made up for an addendum to other qualitative research methods in policy evaluation. Bloor et al. (2001) state that there are basically three different possibilities to use focus groups in policy evaluation.

- "Pre-pilot focus groups" for initial reasoning at the beginning of the research process.
- "Focus groups within the main study or as aid to interpretation", to improve the interpretation of a surveys' results or to recognize the meaning of a defined attitude or behaviour.
- "Focus groups and public participation", to involve a certain target group actively in the research process.

As already mentioned focus groups are not representative. The results therefore do not allow statements concerning the basic population in a statistical sense. This is notably important for policy research.

Straw et al. (1995) discuss the potential uses of focus groups as a formal data collection technique in federal policy and program evaluation studies, why focus groups and other qualitative techniques are often used in federal evaluations and which kinds of misuse exist. An important conclusion of their discussion is that focus groups can benefit evaluators, program staff, policy makers and administrators by providing an in-depth understanding of program effectiveness from the perspective of participants as stakeholders in program outcomes.

F.4 Briefing Paper

This briefing paper was distributed as information material to the participants prior to each focus group session.

Introduction

This short paper outlines the aims of the ImpLore project and the role within it of the focus group sessions, one of which you have been invited to attend. In brief, the project examines R&D programmes and their impact on innovation, exploring in particular the relationship between the design and management of these programmes and the nature and scale of the resulting innovation impacts. Building on an extensive database of R&D programme design features and management aspects, the primary aim of the focus groups which are being conducted in a number of different countries across the EU is to discuss hypotheses linking these attributes to different innovation impacts. A secondary aim is to improve the ways in which innovation-related impacts are monitored and evaluated.

ImpLore is an EU project funded by DG Enterprise and Industry. It sets out to analyse the impact on innovation of publicly-funded research programmes and to explore ways of evaluating these impacts. Much is already known about the so-called knowledge and networking effects of R&D programmes, i.e. about their direct impacts on the knowledge bases, research capacities and networking behaviour of participating research teams. However, relatively little is known about the direct and indirect effects on the innovative behaviour of participating organisations and on the broader innovation systems in which these bodies operate. This is understandable given that the R&D community and the activities it conducts are obviously the primary beneficiaries of R&D programmes, but greater understanding of the ways in which innovation *per se* is affected is vital given that the rationale for most national R&D programmes is to improve the overall performance of the innovation systems in which they are launched.

At the heart of ImpLore is a presumption that the design and management of R&D programmes can affect the nature and scale of the impacts associated with them – both on R&D-related impacts and, further down, on innovation-related impacts. To some extent this is a truism, since poor design and bad management are almost inevitably linked with weak impacts, but there are still a number of open questions about which aspects of sound design and good management are likely to lead to enhanced impacts.

To explore these questions, the ImpLore project has constructed a comprehensive database containing information on over 400 R&D programmes, all of them initiated in different national settings in the EU and elsewhere. Each one of these has been characterised in terms of a number of key design and management features. These span aspects such as the rationale for programmes, their aims and objectives, the scientific and technological fields covered, the orientation of the programmes (for example, towards basic science or R&D more directly related to innovation), the types of participants involved, the size of programme budgets, the selection procedures involved, the existence of accompanying measures designed to enhance exploitation, the extent of the monitoring activities and the existence or non-existence of programme evaluations.

The main goal of the project is to explore the link between features such as these and innovation impacts via the comparison and benchmarking of activities, both across the EU and in a select number of countries elsewhere. A secondary goal is to suggest pragmatic ways of improving the monitoring and evaluation of these impacts. The results of the project will then be presented and discussed at a major international conference and incorporated into a final project report containing, amongst other things, suggestions for the sound design, wise management and effective monitoring and evaluation of R&D programmes intended to have significant impacts on innovation.

The Role of the Focus Groups

Ideally, correlations of the information collected on the design and management features of R&D programmes with similar data on the innovation-related impacts associated with these initiatives would reveal the existence or non-existence of any significant relationships between these variables. Unfortunately, however, it is not possible to collect consistent and comprehensive data on the impacts of all the R&D programmes contained in the ImpLore database, particularly innovation-related impacts. Data is available in some instances, primarily as a result of monitoring and evaluation activities, but only for a small proportion of known programmes. Moreover, even when data is available, it tends to focus primarily on knowledge and networking impacts rather than on innovation-related impacts.

The lack of codified information on innovation-related impacts diverts attention to other sources of information on programme impacts, specifically the tacit knowledge held by policy makers and programme managers about the impacts associated with the programmes they have initiated and implemented in their own national settings. Then there is also the tacit knowledge of a comparative nature held by policy analysts and programme evaluators as a consequence of their professional activities over many years and in many countries.

Therefore, we hold a series of focus group sessions in a smaller number of national settings with carefully selected groups of policymakers, programme managers, policy analysts and programme evaluators. Each session is conducted along the same lines and focuses primarily on the relationship between the design and management of R&D programmes and their innovation-related impacts.

A second point of interest will be an examination of the procedures in place to monitor and evaluate the innovation-related impacts of R&D programmes, specifically with a view towards the promotion of good practice in this sphere.

A third focus will be a specific discussion of the consequences for the design, management and impact of R&D programmes and of recent trends involving the opening up of national programmes to foreign participants and the emergence of transnational R&D initiatives;

The key role of these focus groups as an input to the analytical phase of the ImpLore project is highlighted in Figure 31.

The Format of the Focus Groups

One or more focus groups will be held at least seven national settings: Austria, Germany, Greece, the Netherlands, Poland, Sweden and the UK. Each of these will be attended by:

- Members of the ImpLore project team:
- Policymakers from the host country, particularly those known to have played a significant part in the formulation of policies involving the launch of one or more national R&D programmes;
- Indigenous programme managers with extensive experience resulting from their involvement in the management of one or more national R&D programmes;
- Policy analysts and programme evaluators with a broad-ranging experience of the design, management and evaluation of R&D programmes in a range of different settings.

All these sessions will be held over the period February-April 2007. Participation in each will be limited to 6-10 invitees, excluding ImpLore project personnel, in order to encourage extensive interaction and discussion. If necessary, more than one focus group session will be held in each of the selected countries.

The first step in the process is the distribution of this **briefing paper**, designed to familiarise attendees with the goals of the project and the purpose of the focus groups. The format of the focus groups sessions is shown below:

- Introduction to the workshop and introduction of the participants (15 min)
- Moderator: Presentation of the results for the country in which the focus group is held - Design and management characteristics of R&D programmes in the country (incl. openness) (10 min)
- Discussion: Impact of design and management characteristics on innovation (60 min)
- *Coffee break (15 min)*
- Moderator: Presentation of results for the country in which the focus group is held - Evaluation and monitoring the outputs, outcomes and impacts (5 min)
- Discussion: Evaluating the innovation outputs, outcomes and impacts of R&D programmes (60 min)
- Wrap-up (15 min)

Each session will be conducted over the course of a single day and will commence with an introduction by a member of the ImpLore consortium. This will briefly reiterate the contents of the briefing paper and stress that the main aims of the sessions are to discuss the following:

- The relationship between the design and management of R&D programmes and innovation impacts;
- Pragmatic ways of improving the monitoring and evaluation of innovation impacts.

After all the participants have been given an opportunity to introduce themselves and describe their relevant experience, the first working session will focus on a detailed discussion of innovation outputs, outcomes and impacts. The aim of this session is to establish a shared understanding of these concepts; clarify the differences between these concepts and other R&D-related outputs, outcomes and impacts; and explore the range of potential impact pathways linking R&D programme activities and innovation-related impacts.

The focus group session will take about three hours. The focus group session is introduced by the moderator. The moderator explains and describes briefly the ImpLore project including the final conference. The procedure for conducting the focus group will be explained as well. Each participant has the opportunity to present herself/himself. The moderator presents the empirical results with regard to design and management characteristics of R&D programmes. Overheads or powerpoints will be used to present the most relevant results. This brief presentation opens the floor for the discussion within the focus group. The discussion in this session should focus on the impact of design and management characteristics on innovation in that particular country. The moderator intervenes only if there is a risk that the discussion drifts from the topic. The discussion within the focus group will continue for about one hour followed by a short coffee break. In the second session the moderator the presents results with regard to monitoring and evaluating the outputs, outcomes and impacts of R&D programmes. The following discussion should proceed for about one hour and should focus on evaluating and monitoring innovation outputs, outcomes and impacts of R&D programmes. The final wrap-up enables the moderator to reflect upon the discussion and to provide a kind of summary of the focus group sessions.

F.5 Interview Guide for the Focus Groups

This interview guide was distributed to the moderators of each focus group.

Areas that should be covered by the focus groups:

1) Impact of design characteristics of R&D programmes on innovation

- What are typical design characteristics of R&D programmes in the particular country in which the focus group is conducted?
- What is the main rationale of R&D programmes?
- Is collaboration encouraged?
- How open are R&D programmes to foreign applicants?
- How do those design characteristics impact on innovation?

2) Impact of management characteristics of R&D programmes on innovation

- What are typical management characteristics of R&D programmes?
- How do these management features impact on innovation?

3) Evaluating and monitoring innovation outputs, outcomes and impacts.

- How are R&D programmes evaluated?
- What types of evaluations are applied in R&D programmes?
- How are outputs, outcomes and impacts measured? What indicators are measured?
- What kind of outputs, outcomes and impacts can be expected from R&D programmes?

G APPENDIX 7: THE HIGH LEVEL ADVISORY PANEL

The high level advisory panel performed the accompanying processes of consulting and advising during the whole ImpLore project. This appendix describes the strategic role of the High level advisory panel (HLAP) within the project. This comprises of the objectives, the selection of the HLAP members and the outcome and the benefit of the HLAP meetings for the project approach.

G.1 Objectives

The objective of the HLAP was to provide the contractor and the European Commission with independent external advice on various issues (for example, criteria, indicators, case studies etc.) and to validate the approach of the study from a socio-economic point of view.

The main steps within the project were discussed and assessed by the members of the HLAP. This was with regard to the project's methodology, interim results and key findings. Advice and interpretation from the HLAP were used to enhance the quality of study results to improve the focus of the analysis and to adjust the approach and methodologies used.

Acting as an advisory body the HLAP members shared their experience and knowledge (depending on their position) regarding the design and management of R&D programmes, the implementation of appropriate innovation policies, the impact assessment of R&D activities and the industrial needs regarding public R&D funding. The HLAP members gave advice with respect to further existing sources of material and data relevant to the progress of the project.

They provided interpretations of findings and related them to stakeholders´ interests. They advised in communicating the findings to stakeholders and relating them to political, industrial and scientific contexts. Due to their own respective status the HLAP members were invited to act as disseminators and multiplicators of project results by communicating them in relevant communities (in particular, political, administrative, scientific, industrial communities), by authoring articles or other publications and applying the results within their own operations, thus creating further 'reference cases'.

With respect to their active role in the dissemination of results, the HLAP members took roles within the conference as keynote speakers, speakers in parallel sessions and finally as chair people and rapporteurs.

Due to the fact that the project had a European character and aimed at analysing and evaluating the impact on innovation of publicly-funded research programmes in European countries, the HLAP consisted of 11 persons with a well balanced geographical origin from all over Europe. In addition, the HLAP included three experts from outside the EU. The HLAP included outstanding experts from innovation policy, such as national programme managers or owners, representatives from industry and international research institutions. The HLAP met three times during the project duration in Brussels.

G.2 Methodology

With the proposed tender of the ImpLore consortium a first suggestion for HLAP-members had been delivered (see the primary proposed list of HLAP-member in the appendix).

Based on discussions with the European Commission, further experts were added to the list from which the HLAP members were finally selected (second list of possible HLAP member after discussions with the Commission can be found in the appendix).

As a result of this recruitment process the HLAP comprised eleven persons from all over Europe, North America and Asia and covered industry, public programme management and academia (see the final composition of the HLAP in the appendix).

G.3 Results

With the first consultation of the HLAP, the project consortium of ImpLore discussed research questions and objectives from Lot 1 and accordingly of Lot 2, as both Lots had to be interrelated for dissemination and conference proceedings. In detail, Lot 2 presented their research road map and instruments in use (discussion of focus groups in specifically chosen countries). Finally the panel had a first glance at the conference proceedings. The participants of the first HLAP meeting are listed in Table 33.

Table 33: Participants of the 1st High Level Advisory Panel Meeting, 9th January, 2007, Brussels

Name	*Organisation*
Richard Arning	EADS
Michael vom Baur	AKER Yards CESA
Eelco Denekamp	SenterNovem
Irwin Feller	Pennsylvania State University
Robbert Fisher	Intrasoft (representative from Lot 1)
Ken Guy	Wise Guys Ltd.
Coulton Legge	GlaxoSmithKline
Alberto Licciardello	European Commission
Georg Licht	ZEW
Hans-Peter Lorenzen	DeGEval
Kazuyuki Motohashi	University of Tokyo
Mark O. Sellenthin	ZEW
Jörg Michael Thielges	SIB Berlin Consulting
Nicholas Vonortas	AUEB

Source: ImpLore

With the first consultation of the HLAP the project consortium of ImpLore discussed research questions and objectives from Lot 1 and accordingly of Lot 1, as both Lots had to be interrelated for dissemination and conference proceedings. Going into details, Lot 2 presented their research road map and instruments in use (discussion of focus groups in specifically chosen countries). Finally, the panel had a first glance at the conference proceedings.

Regarding their own role and expectations in the HLAP, the members stated the following:

- Besides the role of the HLAP to comment on the analysis of findings, to identify people for the focus groups and to take over an active role in the promotion and participation in the conference 2007, the HLAP members agreed to foster the communication of results to the management level within industry and programme management institutions.

- The HLAP were prepared to meet before the conference after the summer break to discuss the results from the focus group proceedings.

Concerning the research questions and objectives of ImpLore, remarks and hints from the HLAP member and the commission included the following:

- A preliminary comment should be included concerning the common understanding of innovation throughout the project.

- It was also stated that "monitoring" and "evaluation" should be clearly defined and it was questioned whether the project could define some "prototypes" of programmes.

- The perspective and appraisal of the user groups (for example, industry) is not foreseen so far. The design features seem to refer solely to the economical output and not to the social outcomes from innovation.

- The indicators used in Lot 1 and Lot 2 should be related and should be analysed accordingly.

- The analyst should be aware that sometimes small economies (or sectors) rely on a mono-structured industry, which would restrict the available information about corresponding funding programmes. Thus the database would be slightly contaminated by the low quality of this data which this should be kept in mind whilst analysing.

- Most notably it should have been taken into consideration that the failure of a programme – regarding the 'official' objectives – does not necessarily imply that it has no impact on innovation. Sometimes unintended effects on innovations can be observed.

- It should also be considered that a certain number of 'failed' projects are actually expected (or even in a way desirable) because public funding is only legitimate regarding rather risky R&D projects.

- From the United States a respectable number of studies concerning the industrial outputs of R&D programmes can be provided.

With regard to the presentation of research questions and objectives of Lot 1 and the interrelation between both Lot,s the HLAP commented as follows:

- With regard to the research questions of Lot 1, it should be evaluated whether the experience of failed programmes has been taken into account or not when designing further programmes.
- Further it should be recognised that sometimes contracted evaluators create programmes or project objectives and their fulfilment by themselves.
- The research questions of Lot 1 and Lot 2 should be related to each other, and furthermore should focus on the core question of both Lots, i.e. the impact on innovation by design, management, monitoring and evaluation of R&D projects and programmes.
- It should be kept in mind that common evaluation approaches don't really focus on innovation impact.
- A common understanding of both Lots regarding the hypotheses on innovation impact should be provided.

Focusing the research road map of Lot 2, the following comments had been made:

- Representatives from at least one Romanic country (for example, Italy, France) and one Scandinavian country (for example, Finland, Sweden) should be part of the focus groups.
- Additionally, one comprehensive, cross-national focus group could be set up.
- The focus groups should focus on the management of projects/programmes as a key factor.

The short outline of the conference proceedings brought about the following remarks:

- There is an extensive body of literature on innovation impacts by R&D programmes. How can this particularly contribute to ImpLore?
- The results from both Lots can be the basis for further joint actions concerning collaboration and co-operation on a national and transnational level in order to reach the Lisbon objectives.
- It can be expected that the participants of the conference consist mainly of people with a lot of experience holding high positions in academia, industry and public administration. What information can be provided that is particularly valuable for them?

In the second HLAP meeting the methodology of the survey, questionnaire and the database of R&D programmes were the focus of interest. Furthermore, the focus groups approach was discussed. First results regarding good practice in programme design and management were presented and finally the conference proceedings were discussed. The participants of the second HLAP meeting are listed in Table 34.

Table 34: Participants of the 2nd High Level Advisory Panel Meeting, 27th June, 2007, Brussels

Name	*Organisation*

Jan van den Biesen	Philips Research
Eelco Denekamp	SenterNovem
Angus Hunter	Optimat
Georg Licht	ZEW
Hans-Peter Lorenzen	DeGeval
Adriano De Maio	Regione Lombardia
Wolfgang Polt	Joanneum Research
Rebecca Schindler	MERIT
Mark O. Sellenthin	ZEW
Jörg Michael Thielges	SIB Berlin Consulting

Source: ImpLore

Regarding the methodology, the representatives of the HLAP and the European Commission provided the following remarks:

- It should be kept in mind that the information stemming only from one group of players (programme agencies) might cause a bias.
- The methodology paper could also consider pre-competitive R&D programmes and their effects on industrial products and companies. Industry would claim that not only public subsidies but also industrial input contributed to that success. Furthermore, it might be useful to look for other influences since references to policies in various countries are missing. The general climate of innovation plays an important role. This climate is stimulated by policy.
- Additional database information could be included in the methodology paper (for example, ERAWATCH, EuroTrendchart, OECD)
- Further data sources might cause problems of classification within the study. It will be important to differentiate between other data and the original ImpLore data.

With regard to the collection of data on R&D programmes, the consulted members of the HLAP discussed the following issues:

- The results might highlight underlying strategies: Knowledge orientation is more pre-competitive vs. business orientation which focuses on competitiveness.
- A classification of organisations focussing on knowledge orientation or business orientation could be done. This could be included in the methodology paper.
- A definition of innovation seems appropriate in the methodology paper, for example, the process of extension of knowledge in research institutes might not be defined as innovation.
- The presented results from factor analysis to distinguish between knowledge diffusion and knowledge creation look a bit abstract. The idea could be illustrated by concrete programmes.
- Programmes or projects with a moderate risk can be very successful. Does this characterise programmes regarding their impact of innovation? Furthermore, it the

question is whether pre-competitive, public funding of risky R&D projects should show very high levels of 'direct' economic success.

According to the questionnaire for programme managers the HLAP was asked to revise it until the 5th of July 2007.

Referring to the first focus group results the HLAP and the European Commission provided the following remarks:

- In the Swedish Competence centre programme which was introduced as a good practice example, industry spends one third of the programme budget since the resulting patents are held by firms. Furthermore, the industry sponsors potential future employees by partly funding the programme as a means of strategic personnel recruitment.
- To discuss the industrial perspective and benefits from this kind of funding in detail, further focus groups should integrate the industrial perspective as well.
- The conclusions from Sweden and Greece are similar though the Greek focus group focused on infrastructure as an enabler of innovation impact.
- This infrastructure-related effect might be one main outcome of framework programmes.
- The results from Austria are slightly different since policy makers joined the focus group here. They came to the conclusion that non-targeted bottom-up funding for enterprises might be the most promising approach regarding high impact on innovation.
- The share between industrial and academic participants, their collaboration within programmes might lead to a higher impact on innovation.
- The innovation impact might only occur after some time lag. Therefore the state aid rules launched in the beginning of 2007 authorise any kind of innovation activities.
- It is relevant to push companies – especially SMEs – towards R&D activities. This is the purpose of Germany´s PROINNO programme.
- Referring to the presentation of Lot 1 there is a likelihood of innovation impact from framework programmes. It is increasing since there is a composition of public-private-partnership required for the consortium. It seems to be clear that the shape of the consortium has a relevant effect on the impact.

According to the results from good practice that were presented the HLAP and European Commission representatives discussed the following topics:

- One can distinguish between process, product or service oriented economies. How can these be compared?
- There are other instruments like tax incentives which might have similar (or higher?) effects on innovation than publicly funded programmes (for example, the German BTU Frühphasenprogramm).

- The policy in Italy changed several years ago. Nowadays the regions in Italy are asked to integrate themselves into national strategy and link to other regions. This will cause a more competitive approach between regions.
- It might be worthwhile to include different regions for the whole EU in the ImpLore analysis. For example, perhaps a focus group discussion should be carried out in one of the Italian regions.
- In Germany there are also regional initiatives in strong R&D regions but the national perspective is more prominent in Germany.
- It has to be taken into account that the regional level has nothing to do with the aggregation on a national level. Therefore we need to take into account regional specifications.
- If further information on regional level(s) is available it could be included.
- Different perspectives resulting from regions with different structural preconditions could be addressed in focus groups.

The agenda of the conference programme was discussed and the names for speakers and/or rapporteurs were suggested.

During the third HLAP meeting, the presentation of the project status quo and presentations of conference proceedings were discussed and the key findings from Lot 1, results from Lot 2 as well as emerging findings of focus groups discussion were presented. Finally, emerging practice from the EU and good practice in third countries were presented. The list of participants of the third HLAP meeting is shown in Table 35.

Table 35: Participants of the 3rd High Level Advisory Panel Meeting, 24th September, 2007, Brussels

Name	*Organisation*
Michael vom Baur	AKER Yards CESA
Jan van den Biesen	Philips Research
Eelco Denekamp	SenterNovem
Irwin Feller	Pennsylvania State University
Ken Guy	Wise Guys Ltd.
Angus Hunter	Optimat
Alberto Licciardello	European Commission
Georg Licht	ZEW
Adriano De Maio	Regione Lombardia
Sophia Philippidou	AUEB
Wolfgang Polt	Joanneum Research
Mark O. Sellenthin	ZEW
Nigel Slaughter	Optimat
Marzenna Anna Weresa	Warsaw School of Economics
René Wintjes	MERIT

Source: ImpLore

Besides the presentation of the project status quo and presentations of conference proceedings, the key findings from Lot 1, results from Lot 2 as well as emerging findings of focus groups discussion were presented. Finally, emerging practice from the EU and good practice in third countries were presented.

The presentation of the results of the programme manager survey brought about the following discussion points and advice:

- To assess the reliability and validity of the questionnaire data, a cross-check with other data (for example, database, focus groups) would be necessary.
- The results show relatively little emphasis on IPR and patents. This is in line with the results on framework programmes produced by Lot 1.
- The involvement of industrial representatives in selection panels was discussed since stakeholder involvement was seen as critical in the focus groups.
- Over the last 10-15 years programme managers have increasingly been required to report and achieve impacts on innovation even in R&D programmes
- There seems to be an ambiguous understanding of accompanying measures within programmes: If programme managers are asked about their accompanying measures directly, they rate their importance only on an intermediate level. However, when asked about the most important strategies to improve the impact of programmes on innovation, they list exactly those elements that comprise (modern) concepts of accompanying measures.
- Dissemination might be contra-productive for participants, in terms of knowledge appropriation. A higher pressure on dissemination might prevent these organisations from participating.
- There seems to be a tendency against too many objectives for one programme and rather in favour of a portfolio of programmes.
- There is obviously a lack in formal programme evaluations.
- The cost/benefit ratio for learning from other countries has to be taken into account.
- The role of ERA-Nets as platforms for transnational learning should be kept in mind.

According to the key findings from Lot 1 the following aspects were discussed in particular:

- If there is a very long time delay between the proposal and start of funding, companies will just go on with their work. This effect is mitigated by a constant 'stream of projects' over time.
- There seems to be a conflict between impact and additionality: The data shows substantial impact but not a very high level of additionality. A re-tuning towards

more risky projects would improve additionality but most likely reduce (direct) impact on innovation.

- Among the different aspects of additionality (input, output, and behavioural additionality), behavioural additionality seems most important.

The presentation of findings from Lot 2 raised the following issues:

- Programme managers might be reluctant to stress innovation impact because direct innovation impact is 'forbidden' within publicly funded projects. On the other hand there are more possibilities for SME-related programmes to address innovation directly.

- Also programme managers might view impact assessment as an 'additional bureaucratic burden'.

- Innovation impact means different things in different contexts. This explains the need for the focus group participants to clarify impact definitions and it also adds to the difficulties of interpretation regarding the focus group results.

- In the context analysed here innovation is defined rather restrictively in terms of technological innovation. Instead less crucial things, like helping SMEs to catch up with technological developments should be given lesser importance in the programmes considered.

- The main finding is that there is almost no monitoring of impacts after the end of the projects and programmes.

The emerging practice from the EU was discussed:

- Correspondences between government and company strategies within countries should be analysed. As an example, in Sweden there are thematic programmes driven by a minority of industries which implies a need for a portfolio of programmes.

- The programmes seem rather unconcerned with issues of 'dying industries', and there seems to be a problem to involve industries in need of modernisation.

- The focus on the strengths and weaknesses of the national and regional industrial landscapes and technology clusters is increasing across Europe. This might imply a 'Strengthening the Strengths' approach or addressing strengths as well as weaknesses.

In the course of a general and final discussion within the HLAP, a few general aspects emerged:

- Among the features of good/best practice programmes are: They are rather policy packages of instruments than pure R&D programmes.

- Is there room for cooperation on a European level? The results show that even though learning from past projects is perceived as most important, evaluation and monitoring are not very systematic and agencies do not put an emphasis on learning from others. The conference can make a contribution to shift the awareness towards a better appreciation of the benefits of transnational cooperation.

- There are few opportunities for programme managers to cooperate with their peers; ERA-NETs provide these opportunities. These issues will be taken up in strand 6 of the conference.
- For the conference the focus should be on impact of research, cooperation in assessing impact of research, efficiency of programmes and comparison.
- From a political perspective the focal point is the political objective. Research itself is not an objective, but a tool to reach other objectives. Cooperation depends on shared objectives. There are usually the higher level objectives behind innovation.
- Cooperation between direct actors (agencies) is much more important than cooperation between researchers and evaluators.
- A network to bring evaluators, researchers and practicioners together would be necessary.
- There are agreements between findings regarding national programmes and framework programmes, for example: IPR is regarded as relatively less important; R&D programmes produce surprisingly many direct innovation outputs

G.4 List of HLAP Members

After discussion with the European Commission services, the following list of potential HLAP members has been produced. The final list of HLAP members is shown in Table 36.

A. Industry

- **Michael vom Baur** (Norway) is Senior Vice-President at Aker Yards ASA, Oslo. He is also chairman of COREDES, the working Group on R&D of CESA, the Community of European Shipyards´ Associations.
- **Jan van den Biesen** (The Netherlands). As a Vice President of Philips Research and Director of Public R&D Programmes, he is currently heading EuroPartners, a department facilitating and coordinating Philips' participation in public programmes for R&D partnerships in Europe. In addition, he is representing Philips' R&D interests with public authorities in Europe.
- **René Groothedde** is Secretary General of the European Committee for Cooperation of the Machine Tool Industries CECIMO in Brussels.
- **Coulton Legge** (UK), Technology Development, GlaxoSmithKline, chairs the 'Lab on a Chip' Consortium.
- **Gerhard Romen** (Finland) Vice President Strategic Software, Nokia Internet Communications.
- **Andrea Saroldi** (Italy) is responsible for electronic systems at Centro Ricerche Fiat.

- **Josef Schalk** (Germany) is affiliated at EADS Corporate Research Centre Germany, Munich.

- **Horst Soboll** (Germany) is Chairman of the Research Technology and Innovation Group of UNICE (European Industry association) and Vice Chairman of the European Research Advisory Board (EURAB). Previously, he was affiliated with DAIMLER-CHRYSLER AG, Research and Technology section.

- **Jörg Michael Thielges** (Germany) is CEO of SIB Consulting, Berlin. He was Director Software Solutions & Services at IBM Deutschland Entwicklung GmbH. He was also Technical Excellence Leader of the Microsoft Europe, Middle East and Africa division (EMEA) and President of the Informationstechnische Gesellschaft im VDE (ITG).

B. Academia

- **Irwin Feller** (USA) is Professor Emeritus of Economics from Pennsylvania State University at Pittsburgh. He currently acts as a consultant to the AAAS (American Association for the Advancement of Science), the leading organisation of US research institutions. He published numerous research papers on innovation and R&D policy in scholarly journals.

- **Dominique Foray** (France) holds the Chair of Economics and Management of Innovation at the Swiss Federal Institute of Technology in Lausanne (EPFL). He is also the Director of the College of Management of Technology at EPFL. Previously he was Research Director at the Centre National de la Recherche Scientifique (CNRS) and Professor at the Institut pour le Management de la Recherche et de l'Innovation (IMRI) of the University of Paris-Dauphine.

- **Alfonso Gambardella** (Italy) is Professor of Management at the Università Commerciale "Luigi Bocconi", Milan. He has a PhD from Stanford University (1991).

- **David Hart** (USA). David Hart is professor of public policy at the Kennedy School of Government, Harvard University. His research areas are science, technology, innovation, and public policy, and electoral and advocacy politics.

- **Annamária Inzelt** (Hungary) is Director of IKU Innovation Research Centre at Budapest University of Economics, member of the Executive Committee of PRIME NoE, and founding co-director of Centre for Innovation Policy Research and Education for Central and Eastern Europe in Budapest, Hungary.

- **Francesco Lissoni** (Italy) is professor of Applied Economics at the University of Brescia, Faculty of Engineering, and also works at CESPRI since 1990. He is also managing director of ESSID, the European Summer School of Industrial Dynamics. He was and is involved in various EU projects e.g. STI-NET or the DIME network of excellence.

- **Franco Malerba** (Italy) is Professor of Industrial Economics - Bocconi University, Milan - and the Director of CESPRI, Research Center on Innovation and Internationalization- Bocconi University. He is one of the best known European researchers in innovation economics.

- **Robin Mansell** (UK) is professor at London School of Economics and Political Science, Department of Media and Communications. She is President of the International Association for Media and Communication Research (IAMCR).

- **Kazuyuki Motohashi** (Tokyo). Prof Motohashi (formerly METI / MITI) is affiliated at the Tokyo Center for Economic Research (TCER), Faculty of Economics, University of Tokyo. Previously, he worked for the OECD and METI as a policy analyst in innovation and R&D policy.

- **Florin Philip** (Romania) is Vice-President of the Romanian Academy of Science. He is also member of the EU ISTAG - Information Society Technologies Advisory Group and has been Coordinator of the National Romanian R&D Programme in IT.

- **Philippe Laredo** (France), is Director of Research of the Technical Laboratories, Territories and Societies at the Ecole National des Ponts et Chausses (ENPC), Marne la Vallée, France. He is well experienced in EU funded research projects. Currently he is a principal research of the PRIME network of excellence.

- **Jacques Mairesse** (France) was currently Inspecteur-Général at the Institut National de la Statistique et des Etudes Economiques (INSEE) and researcher at the Microeconometric Laboratory (LMI) at the Centre de la Recherche en Economie et Statistique (CREST). Currently he is professor at the University of Maastricht.

- **María Paloma Sánchez Muñoz** is Professor of Applied Economics at the Universidad Autonoma de Madrid. Her research focus on the measurement and accounting of intangibles and innovation. Currently she is the co-ordinator of the Spanish part of the EU network of excellence PRIME (Policies for research and innovation in the move towards the ERA).

- **Roman Siczek** (Poland), currently head of the Technology Partnership programme in Poland, established in co-operation with Industrial Research Institute for Automation and Measurement, and Warsaw University of Technology. He has many years of experience in diversified engineering (in Poland and in the USA) encompassing design and development of electro mechanical products.

- **Luc Soete** (The Netherlands) is Professor of International Economics at the Faculty of Economics and Business Administration, Maastricht University, the Netherlands, and director of the research institute MERIT (Maastricht Economic Research Institute on Innovation and Technology).

- **Lena Tsipouri**, (Greece) is teaching at the University of Athens, Department of Economic Sciences, specialising in industrial policy and economics of technological change. Previous affiliations were at the Ministry of National Economy, and international organisations.

C. Policy / Programme Management

- **Paul Atkinson**, Deputy Director, Directorate for Science, Technology and Industry (OECD) and Deputy-Director of the International Network for SMEs (INSME)

- **Maurici Lucena Betriu** (Spain). Mr. Lucena Betriu is Director General of CDTI (Centro para el Desarrollo Tecnologico Industrial), a Spanish programme agency concerned with technology oriented programmes for industrial enterprises.
- **Michel Ganoote** (France) is head of the Department Technology & European Affairs at OSEO Anvar.
- **Dong Chul Kim** (Republic of Korea). Mr Kim is President and CEO of ITEP (Korea Institute of Industrial Technology Evaluation and Planning), a major Korean R&D programme management agency. Before this, he was Minister in the Korean Government.
- **Hans-Peter Lorenzen** (Germany) is board member of DeGEval, the German Society for Evaluation. He was formerly head of a sub-department at the German Federal Ministry of Economics and Technology. He has been deeply involved in evaluation and impact assessment issues.
- **Richard Marsh** (USA) Richard Marsh is Vice President of the International Society of Professional Innovation Management (ISPIM), and has over 30 years of experience in product development, new business development and general business management.
- **Dr. Dorothea Sturn** (Austria) is responsible for studies and evaluations at the Austrian Research Funding Organisation - Österreichische Forschungsförderungsgesellschaft mbH. She is a member of the executive committee of the Austrian 'Platform for Research and Technology Evaluation' and a member of the 'European Network for Evaluation'. She also has, from earlier activities as researcher, broad experience in the evaluation of technology and innovation programmes.
- **Petri Peltonen** (Finland) is Executive Director at Tekes. Tekes is the main public funding organisation for research and development in Finland. Tekes funds industrial projects as well as projects in research organisations, and especially promotes innovative, risk-intensive projects.
- **Marc Stanley** (USA) is programme director of the USA Advanced Technology Programme at the national institute of standards and technology (NIST). Before coming to NIST, Marc Stanley was the Associate Deputy Secretary of the U.S. Department of Commerce by Presidential appointment. He has served as a senior policy advisor to NIST Directors, as a consultant to the Department Commerce's Technology Administration, and as Assistant Secretary for congressional and Intergovernmental Affairs at the Department of Commerce. Mr. Stanley earned a B. A. from George Washington University and a Bachelor of Law degree from the University of Baltimore.
- **Willem Zwalve** (The Netherlands). Mr. Zwalve is Vice General Manager of SenterNovem, and also represents the Association for Technology Implementation in Europe (TAFTIE). SenterNovem originated in 2004 from the fusion of two agencies acting on behalf of the Dutch Ministry of Economic Affairs. Their activities are in the domains of innovation, energy, climate, and environment.

Table 36: Final composition of the High Level Advisory Panel

Name	*Organisation*
A) Industry	
Dr. Richard Arning	EADS
Michael vom Baur	AKER Yards CESA
Dr. Jan van den Biesen	Philips Research
Dr. Coulton Legge	GlaxoSmithKline
Jörg Michael Thielges	SIB Berlin Consulting
B) Academia	
Prof. Irwin Feller	Pennsylvania State University
Prof. Kazuyuki Motohashi	University of Tokyo
C) Policy / Programme Management	
Eelco Denekamp	SenterNovem
Dr. Hans-Peter Lorenzen	DeGEval
Prof. Adriano De Maio	Regione Lombardia
Dr. Michael Moon	Korea Institute of Industrial Technology Evaluation & Planning

Source: ImpLore

H APPENDIX 8: CONFERENCE-DOCUMENTATION

One of the core objectives of the ImpLore project was the organisation of an international conference. In the following the objective, methodology, and results of the conference in Berlin on the 23rd and 24th of October, 2007 are summarised.

H.1 Objective

One of the objectives of the ImpLore study was to organise an international conference to present, validate and disseminate results and pave the way for further co-operation of the involved actors in order to maximize the benefits for the European innovation area.

The results of the InnoImpact study (Lot 1) and ImpLore (Lot 2) were disseminated to the European political and science communities in an international two-day conference.

H.2 Methodology

The consortia of both Lots had to present their research results at the conference. Thus, it had to be ensured that both Lots were part of the communication and information strategy of presenting the conference. Brochures, flyers, an internet portal (www.conference.imp-lore.org), and mailing activities kept the audience informed about the ongoing preparation for the international conference.

The structure of the conference was designed so the results from Lot 1 and Lot 2 could be put into a broader perspective for the evaluation and impact assessment of R&D programmes.

The overview regarding practices of R&D policy, impact assessment, measurement of innovation (Plenary I) was followed by three parallel strands dealing with the state-of-the-art in methodologies for evaluation and impact assessment (Strand 1), giving an account of the impact of Framework programme (FP) projects on innovation (Strand 2), and covering the findings about programme design, programme management and innovation impact (Strand 3). Rapporteurs from each strand discussed the key findings from each session in the following plenary (Plenary II).

Focusing on alternative instruments fostering innovation other than R&D programmes, financial instruments and structural funds were presented in the next plenary session (Plenary III). The parallel strands 4, 5 and 6 comprised the improvement of impact indicators (Strand 4), presentation of good practices for a successful approach to impact measurement and evaluation (Strand 5), and introduction of methods for the improvement of programme management and results (Strand 6).

The final plenary discussion (Plenary IV) involved ongoing challenges for the assessment of the impact of public R&D on innovation, and a closing round table discussion focused on the impact of public investment on innovation.

Some of the presenters, moderators and rapporteurs for the conference were simultaneously members of the High Level Advisory Board (HLAP) i.e. distinguished persons with political, industrial, or academic backgrounds. Other candidates had been identified in the international scientific and political communities for evaluation and impact assessment, as the portraits of the presenters, moderators and rapporteurs in the appendix illustrate.

H.3 Results

The conference took place in Berlin on the 23rd and 24th of October, 2007. More than 240 participants worldwide registered for the conference. The following table shows the structure of participants´ nationality, affiliation, and profession.

H.3.1 Conference Results by Plenary Session

PLENARY I *"Getting more out of Public Investment in Innovation Programmes"*

Evaluation and impact assessment aim at measuring the impact of R&D programmes, to provide political decision-makers and programme agencies with the information they need to tune programmes for maximum innovation impact for every Euro invested. This session provided a broad overview of the current discussion, including findings and experiences from across Europe and beyond.

- **Dominique Foray**, Ecole Polytechnique Fédérale de Lausanne, Switzerland
  R&D Policy of Knowledge Creation and Growth
- **Bart Nooteboom**, Tilburg University, The Netherlands
  Measurement of Innovation
- **Dirk Pilat**, OECD, France
  Impact Assessment from OECD Perspective
- **Nicholas S. Vonortas**, George Washington University, USA and Athens University of Economic and Business, Greece **& Wolfgang Polt**, Joanneum Research, Austria
  How much Innovation can you get out of R&D Programmes?
- Moderation: **Christopher John Hull**, Secretary General EARTO, Belgium

Summary:

To get more out of public investment in innovation programmes is a prime concern for decision makers involved in research, technology and innovation policies around the world. In Europe, a special emphasis is put on this issue in view of the so-called 'European Paradox': Excellence in research, lagging behind in innovation and commercial exploitation.

As a prerequisite for a better design and management of publicly funded programmes striving for higher innovation impacts, methodologies have been developed to monitor and assess these impacts. As a general trend, the innovation measurement paradigms have shifted from a primary focus on science (S) to science & technology (ST), and finally to a science, technology & industry (STI) approach. Correspondingly, a broader array of issues is being considered: Beyond inventions as documented in patents, also diffusion, marketing, organisation (intra-organisational), and collaboration (inter-organisational) are considered to be crucial innovation phenomena. In practice, however, there is still a tendency to stick to more closely S&T related metrics. Reasons for this reluctance may be on one hand lacking or not fully developed indicators for organisational, societal and cultural impacts, on the other hand also established habits of thought toward a more conservative and narrow understanding of technological innovation.

As a major trans-national organisation concerned with economic development and innovation, the OECD has provided guiding materials for internationally comparable statistics and indicators that can help to compare and assess innovation performance. Among the most important of these guidelines are

- Frascati Manual: Commonly agreed guidelines to measure expenditure on research and development (updated in 2003)
- Oslo Manual: Guidance to innovation surveys undertaken in many OECD countries (all EU countries, Japan, Canada, Australia, Mexico, etc.) – updated in 2005
- OECD statistical guidelines on information society, biotechnology and human resources

In 2006, the OECD organised the Blue Sky Forum on Indicators in Ottawa, Canada. Among the results of the discussions was the claim for research and indicator development to move from inputs to outputs and impacts of innovation. Also, better coordination and synthesis of research on innovation, and more interdisciplinary approaches were demanded.

The OECD Ministerial Council Meeting of 15-16 May 2007 has mandated the OECD to develop an innovation strategy, recognising the growing political importance of this policy area.

One instrument within such innovation policies are programmes for research, technological development, and innovation (RTDI). To have a closer look into innovation impacts of these publicly funded programmes, the European Commission, Directorate-General Enterprise and Industry, has launched two projects:

- InnoImpact tries to identify innovation impacts of the largest collaborative programmes in Europe – the EU's Framework Programmes (especially 5th/6th FP) for research, technological development, and innovation (RTDI)
- ImpLore looks into the programmes of individual countries to identify programme characteristics that are most conducive for innovation impact

Although programme objectives related to 'direct commercialisation' are still not the most important ones, there are some indications for rather high overall impacts of these programmes on innovation: A great majority of participants in EU Framework Programme projects report at least some form of output that can be commercialised, and a majority of programme managers report innovation impacts to be high or very high from their programmes.

Despite these hints of surprisingly high innovation impacts, firms do not consider these publicly co-financed projects as means to produce results of immediate commercial relevance. Instead they look for opportunities to keep up with state-of-the-art technological development and explore different technological opportunities. Thus, FP projects tend to be viewed by participating organisations as vehicles for exploring new areas, in contrast to self-funded cooperative R&D projects being much more market-oriented. Regarding additionality, there seems to be a fair amount of input additionality in terms of increased corporate R&D intensity, at least in smaller firms (< 100 employees) participating in FP projects. The higher technological and commercial risk of FP projects as compared to self-funded R&D – more novel domains, new partners – also hints at substantial output additionality.

For turning knowledge into practice – and hence tangible outcomes and impacts – some structural preconditions in the science system are also worth considering. Between pure basic research on the one hand and practical problem solving on the other, a crucial pivotal element can be identified: User-inspired basic research. Engineering sciences are prototypes of this pivotal layer, supporting the gradual transformation of knowledge from abstract ideas to operational concepts, adapted to application. This prototypical mode of user-oriented research, as developed in the 'classical' engineering disciplines need not be restricted to these domains. On the contrary, there are tendencies to migrate this research mode to non-technological fields, for example, services ('service engineering'), or education. This tendency should be actively fostered, to develop a science base suited for service economies. Thus, strengthening engineering sciences in this broader sense and creating new ones for a service economy should be high on the agenda, supported by the promotion of adequate managerial practices in industry.

STRAND 1 *"Methodology for Evaluation and Impact Assessment: State of the Art and Good Practices"*

There is a broad range of methodologies to assess the impact of innovation programmes. These methodologies can be pragmatic or sophisticated; the concepts can be executed ex-ante, concurrently, or ex-post. Furthermore they can be performed on either single projects, on the level of single programmes or as a meta-evaluation covering the entire research framework. Speakers will give an overview of the present state-of-the-art across innovation programmes on the national and European level.

- **Terttu Luukkonen**, The Research Institute of the Finnish Economy, Finland
  Methodologies for Impact Assessment – An Overview
- **Irwin Feller**, Pennsylvania State University, USA
  Choosing Methods for Evaluation and Impact Assessment
- **Philip Esler**, Chief Executive of the Arts and Humanities Research Council, UK
  Assessing the Impact of Basic Research – Experiences from the UK
- Rapporteur: **Jacques van der Meer**, European Investment Bank: Projects Directorate
- Moderation: **Adriano De Maio**, Regione Lombardia, Italy

Summary:

Generally, the assessment of impacts from RTDI programmes can be understood as one specific instance of the problem of demonstrating causation in a complex system. In such complex arrays of internal (programme-inherent) and external (political, economic or cultural) factors – often interacting among each other in various ways – it is difficult to attribute supposed 'effects' to supposed 'causes'. In programme impact assessment, it is not possible to create 'real' experiments in order to infer causality.

Facing these challenges, a broad variety of evaluation and impact assessment methodologies have been developed, some of them are listed below:

Econometric models attempt to construct quasi-experiments to analyse functional relationships between economic and social phenomena and to forecast economic effects of innovation programmes. Econometric modelling implies a systematic explication of a programme´s 'theory', and controlling variables for alternative explanations.

A more qualitative approach to inferring causality – or at least chronological development – is historical tracing: Tracing forward from research to a future outcome (prospective, predictive, ex ante) or backward from an outcome to precursor contributing developments (retrospective, ex post).

In surveys, multiple parties are asked a uniform set of questions about activities, plans, relationships, accomplishments, value, or other topics, which can be statistically analysed.

Case studies may be purely descriptive, investigating a program in-depth, a project, or a technology, describing and explaining how and why developments of interest have occurred. In addition, quantifications of economic effects, such as through benefit-cost analysis may complement the qualitative data in a case study.

Sociometric and social network analysis can be used to identify and study the structure of relationships by direct observation, survey, and statistical analysis to describe social or organisational behaviour and related economic outcomes.

For tracking the quantity, quality and impact of research outputs, bibliometrics and patent analyses are approved methods.

Regarding the complexity of the domains to be analysed in programme impact analyses, it is usually not possible to rely on one method alone. Rather, several methodical approaches are combined to balance their respective advantages and disadvantages, and to provide possibilities for cross-checking and data triangulation.

Practical experience has been obtained with all the methodologies mentioned. As examples from the United States, econometric analyses have been applied in the Advanced Technology Program managed by the National Institute of Standards and Technology (NIST). Widely used methods are surveys (for example, the Engineering Research Centers (ERC) Program of the National Science Foundation, NSF) and case studies (for example, the Department of Defense SBIR – Small Business Innovation Research Programme).

A very convincing example for a complex case-study-based approach comes from the United Kingdom. There are seven UK research councils, spending together £ 2.6 billion (€ 3.5 billion, in 2006/7) and covering many scientific and academic domains from Engineering and Physical Sciences (EPSRC), to Economic and Social Research (ESRC), and Arts & Humanities (AHRC). These seven institutions set up a joint impact assessment scheme to investigate outputs and impacts of the research funded:

- Outputs defined as: Codified knowledge (scientific publications, intellectual property), qualifications and skills development, instrumentation, resources and methods, and finally networks.
- Impacts defined as: Development of human capital, business and commercial impacts, (knowledge transfer through collaboration, IP and other commercial activity, clusters and inward investment), policy impacts, quality of life impacts (healthcare, environment, social cohesion, national security, education, culture).

For the impact assessment study, twenty case studies were selected, representing all research councils, different types of activity, and different types of outcomes.

To illustrate the diversity of cases analysed, a few examples are mentioned:

The AHRC-funded Centre for Surrealism led to the Undercover Surrealism exhibition at London's Haywood Gallery, which generated economic impact of at least £ 1 M (€ 1,3 M), has restored the credibility of surrealism research and contributed to development of the creative industries.

The EPSRC Polymer Science Research programme funded basic research leading to exploitation of polymer technology. Successful spinouts include Plastic Logic, having introduced flexible displays, and CDT, recently merged with Sumitomo in an approx. $ 285 M (€ 194 M) deal. Direct and indirect impacts of the programme are estimated to be over £ 200 M (€ 268 M).

In conclusion, it can be stated that a wide array of practically proven methodologies for evaluation and impact assessment is available. In most cases, none of these methods and techniques can fulfil all requirements, so multi-method combinations are usually necessary.

By making proper use of these methodologies, significant contributions to improved policy-making can be achieved, and, conversely, the production of negative knowledge, which is likely to result from poorly performed evaluations, can be avoided.

STRAND 2 *"Impact FP Projects on Innovation"*

The most fundamental level to observe impacts on innovation is the individual R&D project itself. The structure of the project consortium will have an influence on the future exploitation of project results. Management techniques throughout the project life-cycle will also determine the probability of industrial innovation impacts. Besides these factors immanent to the consortium, micro-economic environment conditions – markets, industry landscapes, technologies – need to be considered. Thus, this strand focussed on conditions of innovation impact on project level.

- **Robbert Fisher**, Yellow Perfection s.a.r.l., UK
  Introducing Inno Impact: Objectives, Approach, Participants Characteristics
- **Yiannis Spanos**, Athens University of Economics and Business, Greece
  Project, Firm, Market Characteristics
- **Luca Alessandro Remotti**, Formit Foundation, Italy
  Case Study Design, Execution and Results for Innovation Impact Measurement

- **Nicholas S. Vonortas**, George Washington University, USA and Athens University of Economic and Business, Greece
  Main Conclusions and Policy Implications
- Rapporteur: **Hans-Peter Lorenzen**, DeGEval, Germany
- Moderation: **Jan van den Biesen**, Philips Research, The Netherlands

Summary:

The Framework Programme (FP) for Research and Technological Development attracts the "elite" innovators in Europe, especially firms which are larger, more likely to hold patents, spend comparatively more on R&D, and are more orientated towards international markets. In this regard, the dominant objectives for participation in the FP are 1) to get access to complementary knowledge and skills, 2) to keep up with state-of-the-art technological development, and 3) to explore different technological opportunities. Developing output that can be commercialised immediately is not the main motivation for larger firms to take part in the Framework Programme. In contrast to that, the majority of smaller firms pay more attention to results that can be commercialised.

Organisations participating in FP projects tend to regard these projects as vehicles for exploring new areas, in contrast to self-funded cooperative R&D projects which are primarily used for technology exploitation and therefore closer to the market. In comparison to self-funded R&D projects, FP Projects are reported to have a longer term R&D horizon. They have a greater interest in peripheral technologies, a more explorative nature, a lower degree of flexibility and a higher administrative burden. Additionally, in comparison to the average R&D projects, the FP projects are reported as more complex, more long-term orientated, more risky from a scientific and technical point of view and similar in terms of commercial risk. Intellectual property protection mechanisms such as patents are not often used in FP.

The highest innovation benefit from FP project participation is achieved by enterprises which are medium sized, first-timers and in competitive markets with high innovation/technology intensity. The prior experience of an organization with R&D has a positive influence on obtaining product innovation from FP projects. The FP Projects which are more commercially driven, risky, complex, and in a new area tend to be more successful in terms of innovation. Besides that, there is a strong relationship between explicit intention to commercialise from the outset of the R&D project, and the reported project success. Case studies indicate that project management is a key enabling factor of project success.

A substantial input additionality is reported, especially regarding smaller firms. So, the participation in FP4 or FP5 was associated with a significant jump in R&D intensity between 2000 and 2004 among firms up to 100 employees. In addition to that, several types of commercial outputs by a large number of firms were reported. Higher risk, novelty of technology area, and new combination of partners (newcomers) increase the chance of output additionality.

Overall it can be stated that there is significant positive impact on innovation due to FP. For further development of the FP, the needs of participating organisations, including especially SMEs, have to be better regarded. Furthermore, commercialisation orientation in the proposal stage should be encouraged, and risky, technically complex projects especially in new areas should be more promoted.

STRAND 3 *"Programme Design, Programme Management and Innovation Impact"*

Public funding of R&D activities often takes the format of R&D programmes, combining individual projects into more strategic endeavours on a longer time scale. Specialised institutions and organisations have emerged, involved in managing these programmes. Concepts and experiences in R&D management have developed. Regarding the impact on innovation, it would be interesting to know if certain modes of designing and managing programmes tend to bring about higher or lower, or qualitatively different types of impacts. These relations between programme design and management on the one hand and innovation impact on the other hand are in the focus of this strand.

- **Angus Hunter**, Optimat, UK
  Programme Objectives and Strategies
- **Georg Licht**, ZEW, Germany
  Innovation Impacts and their Link to Programme Management and Design
- **Wolfgang Polt**, Joanneum Research Forschungsgesellschaft mbH, Austria
  Perspective of Policy Makers and Programme Managers
- **Ken Guy**, WiseGuys Ltd., UK
  Challenges for Policy and Scope for International Cooperation
- Rapporteur: **Mario Cervantes**, OECD, France
- Moderation: **Wolfgang Geßner**, VDI/VDE-IT, Germany

Summary:

The design of national R&D programmes significantly differs between EU member countries and this diversity evolves continuously. Empirical results from the ImpLore study indicate that there is no single model of best practice design. The success - in terms of innovation impact - very much depends on the situation in a particular country and the mix of macro-level policies related to innovation and science.

Some general aspects of increasing innovation impact of programmes are related to improving the degree of collaboration and integration between the academic and business communities. It can be observed that a wide range of strategies and instruments are aimed at increasing industry participation and investment in both knowledge integration and exploitation. Furthermore, successful R&D programme design and management differs and clearly depends on what the programme is trying to achieve. For example, different aims such as improving productivity of SMEs or achieving environmental issues are likely to have totally different programme designs. But collaborative R&D programmes are a core component of these policy mixes in all countries.

The learning process on successful programme design features management practices and design of evaluations across organisations and across countries is not well developed. It was pointed out that the innovation efficiency could be enhanced by stimulating such a learning process. In order to increase the impact on innovation, there is a need for improving both monitoring and evaluation practices. Especially the use of quantitative techniques in monitoring and evaluation is still underdeveloped. Therefore the development of indicators and data collection on innovation input factors have to be enhanced.

Besides these aspects, it can be stated that the design and management of all R&D programmes should

- involve stakeholders in the policy and programme formulation stages,
- conceive programmes as complements to other support activities,
- define objectives clearly and keep them simple and few in number,
- communicate objectives to all relevant stakeholders,
- keep the administration simple and the administrative burden on participants low,
- be flexible and allow for changes in direction.

Furthermore, the implications and challenges for innovation policy are evolving policy mixes that embody the above mentioned principles, regard the context specification, and enhance the innovation impacts by encompassing all the affecting impact factors. These impact factors include: dissemination of these lessons as a mandatory requirement in programmes, prioritising science-industry collaboration and co-funding, involving users in the programme design and programme itself, and evolving programmes of sufficient size and duration.

The core challenge is the realisation of all these lessons. International cooperation is one possibility to communicate these lessons and to create an equal basis in institutional learning and memory capabilities by mutual exchange. In reality, however, few programme managers regard benchmarking exercises from similar programmes as a positive impact on innovation. Nevertheless, mechanisms in the EU facilitate policy learning via global cooperation. This mutual learning, management principles and good design is the way to generate policy mixes which are needed to improve innovation performance. ERA-Nets are an example for successful European Cooperation in this respect.

***PLENARY II** "Measuring Innovation – A Bold Venture or a Critical Endeavour?"*

- Rapporteur from strand 1: **Jacques van der Meer**, European Investment Bank: Projects Directorate
- Rapporteur from strand 2: **Hans-Peter Lorenzen**, DeGEval, Germany
- Rapporteur from strand 3: **Mario Cervantes**, OECD, France
- Moderation**: Christopher John Hull**, Secretary General EARTO, Belgium

Summary:

Methodologies of evaluation and impact assessment are core issues for the international community for impact analysis. There is a set of quantitative and qualitative methods practically proven in measuring output, outcomes and impacts of funding programmes. In most cases, not only one of these methods and techniques can fulfil all requirements, so multi-method combinations are usually necessary. Thus the "Why?" and "What?" and "How?" is of major interest for any kind of assessment and determines the set of appropriate methods. The choice depends on the specific interest and the context of evaluation and impact assessment.

Challenges for an appropriate application of evaluation methodologies lie in different requirements on the national and European level. Within the ERA, the diversity of objectives causes a diversity of funding programmes on a national level embedded in specific national contexts. Programme designs are related to national research and innovation policies and individual practices on country level. Leading countries in the European Innovation Scoreboard (EIS) may refer more often to thematic programmes whereas following and catching-up countries may prefer the strategy of open calls.

On a strategic level, the European Framework programmes (FP) help to bridge the gap between diverging national interests and common European objectives. Thus programme design and management on European level may differ from national ones and thus require other evaluation and assessment schemes.

Both schemes put forward the need for a diversity of evaluation and impact assessment and to face cultural barriers as well as the lack of a target setting and taking stock of the programme information.

By making proper use of these methodologies, significant contributions to improved policy-making can be achieved.

PLENARY III *"Experience from R&D Programmes, Financial Instruments and the Structural Funds"*

R&D programmes are not the only way to foster innovation. Other means of support within the European innovation policy system are financial instruments, such as R&D loans or tax reductions. Furthermore, EU Structural Funds are also expected to have a substantial impact on socio-economic innovation. In this session, approaches and practices of impact measurement and management will be compared across these three areas of innovation policy.

- **Asterios Chatziparadeisis**, Ministry of Development, Greece: Structural Fund
  Impact of Structural Funds on Innovation
- **Jacques van der Meer**, European Investment Bank: Projects Directorate
  Assessing the Impacts of Financial Instruments
- **Michel Poireau**, DG Research, Belgium: R&D Programmes
  The Role of RTD Framework Programme in Stimulating Innovation in Europe
- Moderation: **Jörg-Michael Thielges**, SIB Berlin Consulting, Germany

Summary:

The fostering of innovation by public institutions may take various forms. R&D Programmes are just one of them.

On national as well as European and international levels, financial instruments – as means of public innovation policies – are available to open new channels for companies to access external financial resources (loans, venture capital, guarantees).

Specifically in the European Union, four Structural Funds have been developed as another instrument to grant financial assistance to resolve structural economic and social problems:

- the European Regional Development Funds (ERDF), whose principal objective is to promote economic and social cohesion within the European Union through the reduction of imbalances between regions or social groups;
- the European Social Fund (ESF), the main financial instrument allowing the Union to realise the strategic objectives of its employment policy;
- the European Agricultural Guidance and Guarantee Fund (EAGGF - Guidance Section), which contributes to the structural reform of the agriculture sector and to the development of rural areas;
- the Financial Instrument for Fisheries Guidance (FIFG), the specific fund for the structural reform of the fisheries sector.

When combined the EU promotes innovation by several policies and instruments

- the Lisbon Strategy, which gives high priority to innovation after the revision of 2005
- the Seventh Research Framework Programme (FP7) with an increased budget in comparison to the previous Framework Programmes
- the Competitiveness & Innovation Framework Programme (CIP)
- the Community Strategic Guidelines on Cohesion with three priorities, one of which is "encouraging innovation, entrepreneurship and the growth of the knowledge economy by research and innovation capacities, including new information and communication technologies"
- the Structural Funds.

Among these policies, instruments and programmes, the Competitiveness & Innovation Framework Programme (CIP) includes financial instruments as one major strand, specifically to support innovation in SMEs. These instruments are managed by the European Investment Fund (EIF) and the European Investment Bank (EIB). Recently, the European Commission and the European Investment Bank (EIB) have joined forces to set up the Risk Sharing Finance Facility (RSFF) for support in FP7 on the basis of shared risk research projects.

Based on EU Treaty Art. 163 and 267 within the Lisbon Agenda and specifically the Competitiveness and Innovation Framework Programme (CIP), the European Investment Bank has set up the Innovation 2010 Initiative (i-2019-i). From 2000 to 2006, the EIB has signed loans to a total amount of € 44.8 billion under i-2000-i for the following range of activities:

- R&D and innovation;
- Cooperation: Research infrastructures, research and technology platforms, networks and initiatives, FP-projects,
- People: strengthening of human R&D/S&T skills and potential, centres of excellence, research hospitals
- Capacity: regional endowment for R&D, including science and technology parks and clusters, R&D-centres,

- Ideas: private and public sector investments in research and innovation; co-operative R&D, prototypes and test installations.
- Education and Training: modernisation/ upgrading of education facilities; training centres for teachers, vocational training centres, ICT-specialist, accessibility (student loans), etc.
- ICT: Development of information and communication technologies and networks, modernisation and extension of networks, enhancing accessibility, media.

The Structural Funds also play a substantial role in promoting research and innovation in the European Union. Between 2000 and 2006, roughly € 13 billion were spent on research infrastructure and networks, innovative business start-ups and the modernisation of small and medium-sized enterprises, financed through the Structural Funds. There is an even higher priority for innovation in the next programming period 2007 – 2013. The Cohesion Policy Regulations give a prominent position to investment in research and innovation and set a quantitative target of 60% to 75% to be allocated to operations leading to growth and jobs. These targets do not exclusively relate to innovation, but they confirm the new framework within which Cohesion Policy will work. Furthermore, the European Research Advisory Board, EURAB, has called for measures to increase the use of Structural Funds for enhancing research and innovation following the Aho Commission´s (Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit and chaired by Mr. Esko Aho) claim to increase the proportion of structural funds spent on research and innovation.

A specific example from one member state (Greece) is the Operational Programme 'Competitiveness' within the Community Support Framework 2000-2006, which is a development plan agreed to and adopted by both the Greek Government and the European Commission regarding Objective 1 assistance to the Greek regions for the period 1/1/ 2000 - 31/12/ 2006. This framework follows three strands: Support of R&D infrastructures, support of research projects, and support of the human capital (researchers). Also non-R&D innovation is supported,, for example, the modernisation of SMEs.

Besides financial instruments, the third – and probably most prominent – pathway of public innovation support is R&D programmes among which the Framework Research Programmes (FPs) of the European Commission are of special importance. From FP1 (1984-87) to the current FP7 (2007-2013), the total budget has developed from approximately € 5 billion to about € 50 billion (calculated in 2004 prices). The FPs tried to overcome barriers to innovation with a focus on collaboration (university and industry), transboundary dimensions, shared costs, and pre-competitive research.

FP7 is designed as part of reinforced public research effort in Europe. Apart from an increase in resources, also links with member states have been improved. In this context the ERA concept (European Research Area) and ERA-NET instrument – aiming at the co-ordination and cooperation of national and regional programmes – are core elements. Basic research is emphasised as a source of disruptive innovations and stakeholders – especially the industry – are encouraged to develop shared objectives because of the common European Technology Platforms (ETPs).

Regarding the assessment of impacts achieved by employing these different approaches to innovation support there are some experiences from the ex-ante appraisal of projects to be considered for financial instruments. From the EIB´s practice four key issues seem to emerge, distinguishing between successful and less successful R&D projects:

- Definition of and congruence between strategic corporate goals and RDI (research, development, innovation) goals: What (new markets, new/improved products or design, technology, cost reductions, etc.?), why, when, where, how, by whom and for how much?
- Resources: endowment, quality, availability, accessibility
- Distinction and measurement of efficiency and effectiveness
- Organisational structure and climate: Team-design, culture, management style and attitudes, rewards, legal framework, etc.

Interestingly, these latter 'soft' indicators seem to be at least as important in predicting success as more conventional 'hard' data.

For the European Framework Research Programmes (FPs), an elaborate impact assessment approach has been established, consisting of three columns:

- Yearly monitoring, focusing on the obeying of rules
- 5-year retrospective assessment
- Specific impact assessments: For example, Energy, NMP (Nanosciences, Nanotechnologies, Materials and New Production Technologies)

Regarding specific programmes, there are interesting results providing some insight into the factors for the success and failure of R&D projects. As an example the ex post analysis of finished Growth FP5 projects brought about the following results:

- Main factors for success were: Scientific-technical excellence of the researchers and the management skills of the coordinator
- Other features of the project leading to more success: Coherence of the project with the core business of the main industrial partners, exploitation capability of the partnership, project budget (critical size effect) and an appropriate number (neither too many nor too few) of excellent research partners
- Main factors leading to failure were: Overambitious technical objectives / technical complexity, lack of a business/exploitation plan and a lack of cost-competitiveness of the developed technology
- Other features of the project leading to less success: Having the main industrial partner as the coordinator, projects that would not have been undertaken at all without EU funding and not high quality inconsistent management performance throughout a project.

STRAND 4 *"Impact Indicators: How to Improve the Accountability of a Programme's Outcome?" (Summary)*

The core problem of impact assessment is the measurement of the impact itself: Was technological development stimulated? Was there any successful economic exploitation? How many Euros of impact were generated for each Euro of funding? Accountability – may be quantitative or qualitative (or both), rough and broad or fine and specific – is of increasing importance. In this session ways to improve accountability of R&D programmes were highlighted. Several examples of indicator development and usage were presented and practical experiences were introduced and discussed in order to facilitate learning from international experiences.

- **Isabelle Collins**, Technopolis, UK
  Impact Indicators and Impact Assessment: Experience from IST WING Evaluation
- **Bernard Bobe**, Ecole Nationale Supérieure de Chimie de Paris (ParisTech) & Consultant, France
  Experience from Impact Assessment of EUREKA Programmes
- **Krzysztof Gulda**, Director of Economy Development Department – Ministry of Economic Affairs, Poland
  Designing Programmes and Evaluation and their Role for Accountability of Innovation Impacts
- Moderation: **Michael vom Baur**, Akeryards ASA, Norway

Summary:

Successful impact assessment relies on adequate indicators. Regarding the methodology of evaluation it can be stated that there is a set of reliable and proven indicators, but it is important to keep in mind that the adequacy of indicators depends strongly on the programme context and instruments at hand.

Programmatic R&D funding is situated in the legal and institutional conditions of respective economic and political systems and is being developed according to objectives of innovation and science policies. This sets the framework for programme monitoring and impact assessment.

These structures and processes will differ between 'catching-up' countries and more sophisticated science and innovation systems. In any case programmes and initiatives will be designed based on the experiences of past, similar programmes and initiatives and oriented towards political objectives. This also holds for European programmes and initiatives (like IST or EUREKA).While evaluating these programmes and initiatives the intended or expected impacts – scientific, technological, economic, societal, political, and regulatory – need to be considered.

Thus, core requirements of effective impact assessments are clear-cut objectives and expectations regarding impacts. These objectives and expectations define levels of evaluation and possible sets of adequate indicators.

A special challenge regarding indicator selection and development concerns the collaborative level when objectives and expectations of member states need to be regarded and evaluated. For this purpose a preceding negotiation and agreement process regarding indicators and impact analysis methodology is necessary. The more comprehensive this impact assessment is, the more reliable and valid are the conclusions regarding successful programme design and management. These can then be implemented accordingly.

All available evidence indicates that a core success factor of projects – and, on a higher level, of programmes – is the 'tuning' between consortia, programme level objectives,and assessment procedures, whereas a 'natural selection' occurs regarding market or technology environments.

Strand 5 *"Good Practices: Successful Approaches to Impact Measurements and Evaluation" (Summary)*

Impact measurement and evaluation are demanding and not trivial tasks in order to find ways to implement reliable instruments in a way suitable for practical programme management. But,fortunately there are examples of successful practice. These examples are presented in this overview – as a 'landscape' of good impact assessment practice in Europe and exploring cases of advanced programme management and design in detail.

- **Torbjörn Winqvist**, Vinnova, Sweden
  Impact of R&D seen in a Long-term Perspective
- **Markus Koskenlinna**, TEKES, Finland
  Impact Analysis in Tekes
- **Stephen Campbell**, NIST, USA
  Lessons from impact assessments of the former U.S. Advanced Technology Program
- Moderation: **Yannis Caloghirou**, National Technical University of Athens, Greece

Summary:

There are political objectives regarding programme impact, to be brought about by programme design and management which are subject to accountability. Limited public resources require impact assessment and also the need to use available funding instruments in the most effective and efficient way, lead to the development of impact assessment methodologies as presented in this session.

It is well known that concurrent as well as ex-post assessments may well identify effects but it still remains a challenge to attribute these effects to the funding instruments in a direct, causally linked way. Moreover, these effects may need years to develop and become visible. Despite this time lag subsequent programmes will usually be designed on the basis of impact assessments of precursor programmes finished a short time ago or even still in operation.

Therefore, a core issue in programme evaluation and assessment is long-term monitoring in order to measure these long-term effects. This calls for an appropriate evaluation strategy, being designed and performed to cover post-programme effects. In evaluation studies of this kind various methods are used. The evidence shows that long-term effects of funding programmes tend to exceed the effects measured on a short-term scale. Also late discoveries of programme design and management flaws are as useful for programme improvement as evidence of successes.

In studies regarding impacts on individual project partners, important effects on their economic situation and innovation capability have been found (for example, patenting, increased proportion of R&D staff) which also imply positive effects on the research and innovation system as a whole.

Strand 6 *"Learning from Impact Assessment – Improving Programme Management and Results" (Summary)*

Innovation agencies have adopted the concepts of additionality and EFQM Excellence© to functional methodologies for the improvement of ongoing or future innovation support programmes. "Friendly" reciprocal or internal peer review and consulting are utilised to detect and analyse improvement potentials with the objective to realise them in systems for rapid and/or continuous improvement. In this session these approaches were presented to enable agencies and policy makers to judge the potential use for their own programmes.

- **Peter Hahn**, VDI/VDE-IT, Germany
  IMQ-NET
- **Kjell-Håkan Närfelt**, Vinnova, Sweden
  TAFTIE Task Force on Additionality: Making Agencies make a Difference
- Moderation: **Gerd Meier zu Köcker**, VDI/VDE-IT, Germany

Summary:

Especially innovation agencies apply the European Foundation for Quality Management (EFQM Excellence©) approach to improve their performance in a structured way.

The EFQM approach was – for the first time in this domain – exemplarily implemented within IMQ-Net. Also this implementation process was accompanied and monitored. As a result many advantages and few disadvantages were found regarding agencies´ practices.

The experimental implementation phase demonstrated that such a self-management framework for quality management needs to be implemented in a cooperative way involving all participants. Thus external evaluation is somewhat neglected even though it is frequently expected and called for. This approach was applied by the Task Force on Additionalities of TAFTIE (The Association for Technology Implementation in Europe) in order to develop targeted measures for efficiency improvement in programme design and policy implementation. For this purpose the Task Force developed a self-assessment process for programme agencies, enabling the agencies to reflect on and improve their programme design and management processes in a structured process and to use the results of this process for an active re-shaping of the programme design and management.

Experiences from these activities show that a common understanding between agencies of evaluation and impact assessment methodologies is essential. Moreover feedback loops within these evaluation and design processes bring about the desired effects regarding the quality of programme management and programme design.

Plenary IV *"Challenges for the Assessment of the Impact of Public R&D on Innovation" and "Impact of Public R&D on Innovation" (Summary)*

Measuring and managing innovation efficiency is a growing concern on different levels: For the individual enterprise, in innovation programmes, and in national innovation systems. The challenge is always the same: Assets and funds are limited, and maximum impacts on the economy and society are desired. Common problems bear common solutions. Thus, communication on practices and evidence in innovation impact assessment should lead to international learning and provide the governance of innovation policies with knowledge about indicators and determinants of innovation efficiency.

- **Susan Cozzens**, Georgia Institute of Technology, USA
- **Impact of Public Investment on Innovation (Round Table)**

- During the final round table discussion the participants debated on the role of innovation policy with respect to the innovation impact. The lessons learned that were presented during the conference also implicate transferable lessons for policy action plans. The key question within this session was to identify policy-relevant solutions.
- **John van den Elst**, Philips Applied Technologies, The Netherlands
- **Susan Cozzens**, Georgia Institute of Technology, USA
- **Isabel Busom**, University of Barcelona, Spain
- **Yannis Caloghirou**, National Technical University of Athens, Greece
- **Michel Poireau**, DG Research, Belgium
- **Kazuyuki Motohashi**, University of Tokyo, Japan
- Moderation: **Nicholas S. Vonortas**, George Washington University, USA and Athens University of Economics and Business, Greece

Concluding Remarks

- **Pierre Vigier**, European Commission

Summary:

Besides economic objectives in the narrower sense, societal challenges regarding health, environment and social cohesion call for a focus on the quality of life issues in innovation assessment. Societal and economic prosperity cannot be achieved without publicly funded research.

In this regard a broadened set of objectives call for changes in the system of programme design, programme management and evaluation and impact assessment. Publicly funded programmes address a wide range of stakeholders and require impact assessment experts qualified and educated for this context who are able to understand not only impacts on socio-technical systems but also social and environmental development dynamics.

In the future programme design and management will have to respond to these societal challenges and sets of socio-economic objectives. This broadened perspective on innovation should to be reflected in impact assessment methodology and indicators as well as in the adjustments made to programme design and management based on these assessments.

As the experience and evidence presented at this conference demonstrated, all member states face these challenges in a similar way. Therefore in the words of Pierre Vigier, "mutual policy learning" and "mutual policy doing" should be the focal points of interest for the future.

H.3.2 Conference Participants

Table 37: Number of participants of the ImpLore conference by country and institutional background

Continent	*Country*	*Ministry and political entities*	*Pro-gramme agencies*	*Univer-sity*	*Research*	*Company*	Σ
Europe (223)	Austria	3	2		6	1	12
	Belgium	3	3		2	3	11
	Bulgaria				1		1
	Denmark	1	2		1		4
	Finland		2		1		3
	France	3	2	2			7
	Germany	9	15	7	17	20	68
	Greece	1		4	2	2	9
	Hungary		2				2
	Iceland		1				1
	Ireland		1				1
	Italy	2	2		3	4	11
	Lithuania		2				2
	Luxembourg		1		2	4	7
	Netherlands	1	1	5	1	4	12
	Norway				3	1	4
	Poland	7		12	6	3	28
	Portugal	1			1		2
	Romania				1		1
	Russia					1	1
	Spain		1	1	1		3
	Sweden	1	6		3		10
	Switzerland		1	1	2		4
	Turkey			2	1		3
	United Kingdom		4	3	2	7	16
Africa (1)	Ghana				1		1
Asia (5)	Iran			1	1		2
	Japan			1			1
	Pakistan					1	1
	South Korea				1		1
America (5)	USA		2	1	2		5
	Total	32	50	40	61	51	234

Source: ImpLore

Table 38: Gender distribution of conference participants

Male	*Female*	*Total*
161	73	234

Source: ImpLore

Table 39: List of Participants

Name	*Organisation*	*Country*
Selcuk Akgul	Universitek Ed. & Cons.	Turkey
Prof. Susan Alexander	Minerva Sarl	Luxembourg
Effie Amanatidou	Research & Innovation Policy Analyst	Greece
Birgit Aschhoff	Center for European Economic Research	Germany
Michael Astor	Prognos AG	Germany
Efthymia Athanasiadou	Cyprus Trade Centre Berlin	Germany
Dr. Laurent Bach	University Strasbourg	France
Carola Becker	Projektträger Jülich PtJ	Germany
Dr. Stefan Behrens	Forschungszentrum Jülich	Germany
Prof. Dr. Andrzej Bernacki	Polish-Japanese Institute of Information Technology	Poland
Jacek Bialek	Ministry of Regional Development	Poland
Dr. Benat Bilbao Osorio	OECD	France
Frank Bingen	Fonds National de la Recherche	Luxembourg
Fabio Bisogni	Formit Foundation	Italy
Dr. Pierre Bitard	ANRT	France
Jane Bjørn Vedel	Danish National Advanced Technology Foundation	Denmark
Prof. Dr. Bernard Bobe	Ecole Nationale Supérireure de Chimie de Paris	France
Dr. Ivan Boesso	Veneto Innovazione S.p.A.	Italy
Dr. Karen Böhme	Projektträger Jülich PtJ	Germany
Prof. Dr. Jochen Breinlinger-O'Reilly	Fachhochschule für Wirtschaft Berlin	Germany
Marija Breitfuss	Joanneum Research	Austria
Annelies Bruhne	Leibniz Universität Hannover	Germany
Ina Buck	Projektträger Jülich PtJ	Germany
Angelika Buehler	Pro Beruf and Evaluation	Germany
Tobias Buser	Swiss Federal Research Institute WSL	Switzerland
Prof. Dr. Isabel Busom	Universitat Autonoma de Barcelona	Spain
Dr. Hans-J. Buss	Innovationszentrum Niedersachsen	Germany
Peder Bylander	Sensors & Instrumentation Knowledge Transfer Network	United Kingdom
Prof. Dr. Yannis Caloghirou	National Technical University of Athens	Greece

Name	*Organisation*	*Country*
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Funda Celikel Esser	European Commission JRC	Italy
Mario Cervantes	OECD	France
Dr. Asterios Chatziparadeisis	Ministry of Development	Greece
Dr. Hyosung Chiang	Korea Institute of Industrial Technology Evaluation and Planning	Republic of Korea
Dr. Oxana Chorna	Wyzsza Szkola Biznesu - National-Louis University	Poland
Dr. Thomas Alslev Christensen	Ministry of Science, Technology and Innovation	Denmark
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Nick Constantopoulos	Gen. Secretariat for Research and Technology	Greece
Prof. Dr. Susan Cozzens	Georgia Institute of Technology	USA
Silvia de la Maza	Asociacion de Empresas Tecnologicas Innovalia	Spain
Jesus De Las Cuevas	Sodercan	Spain
Prof. Dr. Adriano De Maio	Regione Lombardia	Italy
Dr. Enrico Deiaco	Swedish Institute for Studies in Education and Research	Sweden
Dr. Ronald Dekker	Delft University of Technology	Netherlands
Valentina Diana	Filas – Finanziaria laziale di sviluppo	Italy
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Peter Dortans	VDI/VDE Innovation + Technik GmbH	Germany
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Prof. Dr. Dominique Foray	Ecole Polytechnique Fédérale de Lausanne	Switzerland
Andrea Frank	Stifterverband für die Deutsche Wissenschaft	Germany
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Klaus Peter Friebe		Germany
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Prof. Wilfried Ruetten	european journalism centre	Netherlands
Dr. Steliana Sandu	Romanian Academy, Institute of National Economy	Romania
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Rebecca Schindler	UNU-MERIT	Netherlands
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Prof. Dr. Aleksander Sulejewicz	Warsaw School of Economics	Poland
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Dr. Wladyslaw Switalski	University of Warsaw	Poland
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Dr. Geert Thijssen	SenterNovem	Netherlands
Susanne Thorwarth	Center for European Economic Research and K.U.Leuven	Germany
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Burcu Uslu Özdemir	Bilkent University	Turkey
Dr. Jan van den Biesen	Philips Research	Netherlands
Dr. John van den Elst	Philips Applied Technologies	Netherlands
Dr. Jacques van der Meer	European Investment Bank	Luxembourg
Marcus van Leeuwen	NWO	Netherlands
Ton van Lier	Brainport	Netherlands
Dr. Johannes Velling	Bundesministerium für Wirtschaft und Technologie	Germany
Enikö Veres	Joanneum Research	Austria
Pierre Vigier	European Commission	Belgium
Michael vom Baur	Aker Yards ASA	Norway
Prof. Dr. Nicholas Vonortas	George Washington University	USA
Prof. Dr. Tim Vorley	University of Cambridge	United Kingdom
Ralph Warnke	MediTECH Electronic GmbH	Germany
Fred Warnke	MediTECH Electronic GmbH	Germany
Boguslaw Weglinski	Warsaw University of Technology	Poland
Florian Weiss	VDI/VDE Innovation + Technik GmbH	Germany
Prof. Marzenna Weresa	Warsaw School of Economics	Poland

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Dr. Jan Wessels	VDI/VDE Innovation + Technik GmbH	Germany
Dr. Werner Wilke	VDI/VDE Innovation + Technik GmbH	Germany
Jan P. Windmüller	Danish Agency for Science, Technology and Innovation	Denmark
Torbjörn Winqvist	VINNOVA	Sweden
Dr. Rene Wintjes	UNU-MERIT	Netherlands
Peter Wolfmeyer	ZENIT GmbH	Germany
Richard Woodham	Intrasoft International	Luxembourg
Jannika Wouters	VDI/VDE Innovation + Technik GmbH	Germany
Aleksander Wrzesien	Warsaw School of Economics, Aarhus School of Business	Poland
Marcin Zembaty	Ministry of Economy	Poland
Thomas Zuleger	Bundesministerium für Wirtschaft und Technologie	Germany

Source: ImpLore

H.3.3 Profile of presenters, moderators and rapporteurs

Bernhard Bobe

Professor of Economics and Management, Ecole Nationale Supérieure de Chimie, University Pierre & Marie Curie, Paris. Prof. Dr. Bernard Bobe has been a member and Chairman of Continuous and Systematic Evaluation Committees of the Eureka Programme between 1996 an 2004.

Isabel Busom

Isabel Busom is Professor of Economics at the Universitat Autonoma de Barcelona, Spain. She has a Ph.D in Economics from the U.A.B. and holds a Master of Arts in Economics from the University of Pennsylvania. Her research activity focuses on the empirical analysis of innovation policy, and in particular on the effects that public support has on firms' decisions concerning their R&D activities. Her work has been published in specialized academic journals such as Research Policy, Economics of Innovation and New Technology and Spanish Economic Review. She also has numerous contributions in books, monographs and reports related to the economic determinants of innovation.

Yannis Caloghirou

Associate Professor of Economics of Technology and Industrial Strategy at the National Technical University of Athens. He has been Secretary General for Industry and Secretary for the Information Society in Greece. He has been a part of a number of EU high-level expert groups. His main research interests are in the fields of innovation studies and the socioeconomic and strategic aspects of the

ICTs. In addition to other publications he also co-edited two books on European collaboration in R&D and knowledge flows in the European industry.

Stephen Campbell

Stephen Campbell joined the Advanced Technology Program (ATP) in August 2001. He currently serves as both an economist for the Economic Assessment Office (EAO) and as the senior advisor to the director of ATP. He has served as an economic expert on the Information Technology, Electronics, and Advanced Materials/Chemistry selection panels. He also served as overall chair for the Materials/Chemistry panel during the 2004 ATP competition. Steve has worked in developing and analyzing all elements of ATP's data collection efforts including surveys of awarded organizations during and post funding, surveys of awardees and non-awardees in selection competitions and a special survey of ATP research joint ventures. His research has been in the areas of the determinants of success in ATP projects, evaluating the ATP selection process and examining if ATP crowds out private funding of R&D. He is a member of the American Economic Association and the American Statistical Association.

Mario Cervantes

Mr. Mario Cervantes is a senior economist at the OECD's Directorate for Science, Technology and Industry since 1995. In this position Mr. Cervantes is responsible for managing various projects mandated by the OECD's Committee for Scientific and Technological Policy whose goal is to provide empirically-based policy advise to the OECD's 30-member countries as well as China, Israel, Russia and South Africa.

Asterios Chatziparadeisis

Asterios Chatziparadeisis holds a Ph.D. in Statistics and he has been working in the Hellenic Ministry of Development since 1984 in the production of statistics and indicators for Research, Technology and Innovation. Since the beginning of '90s he has also been involved in policy making for Research and Technology where he has been responsible for the elaboration of the Structural Programs in Greece for Research and Technology for the periods 1994 - 1999 and 2000 – 2006. He is also responsible for the Structural Program "Competitiveness and Entrepreneurship" which covers several domains (R&D, Industry, Energy, Tourism, Trade etc) for the programming period 2007 - 2013.

Isabelle Collins

Isabelle Collins has extensive experience in European and UK Public Policy work in the field of organisational structures and reform, information society, regional development and business support. This includes evaluation, research, and project management. Currently she is carrying out an ex-post impact assessment of the IST Programme, together with an international team of experts looking mainly at the work financed under the Fifth Framework Programme. She is also working on a number of other impact assessments and evaluations with special interest in the methodological aspects.

Susan Cozzens

Susan Cozzens is Professor of Public Policy and Director of the Technology Policy and Assessment Center at the Georgia Institute of Technology. Dr. Cozzens' research interests are in science, technology, and inequalities and science, technology, and innovation policy in developing countries. She is active internationally in developing methods for research assessment and science and technology indicators. From 1998 through 2003, Dr. Cozzens served as Chair of the Georgia Tech School of Public Policy. From 1995 through 1997 she was Director of the Office of Policy Support at the National Science Foundation. The Office coordinated policy and management initiatives for the NSF Director, primarily in peer review, strategic planning, and assessment. Before joining Georgia Tech, Dr. Cozzens spent eleven years on the faculty of Rensselaer Polytechnic Institute. She has a Ph.D. in sociology from Columbia University (1985) a bachelor's degree from Michigan State University (1972, summa cum laude).

Adriano De Maio

A graduate of Electronic Engineering (1964) from the Politecnico di Milano, he is now full-time Professor of the Management of Innovation. Moreover he was the Rector and President of Politecnico di Milano (1994-2002) and of Luiss Guido Carli in Rome (2002-2005), the Commissioner at National Council of Research CNR (2003-2004) and the Chairman of Evaluation Committee of Public Research Centers and of Advisor Committee to the Ministry for higher education reform (2002-2004). Additionally he is the President of TIME (association of top level European technical universities) (2000/2002)and a member of the board of Ecole Centrale Paris where he received a honoris causa Ph.D. He is also the Chairman of Investment Committee of the Next Venture Capital Fund and the author of books and articles especially regarding the management of innovation and research. At present is also counsellor to the Governor of Regione Lombardia regarding higher education, research and innovation.He is also the President of Regional Institute of Research (IreR).

Philip Esler

Philip Esler became Chief Executive of the AHRC in September 2005. Before venturing into academics, Professor Esler worked for 10 years as a litigation solicitor and then as barrister in Australia. In October 1992 he moved with his family to St Andrews where he took up a position as a Reader of the New Testament. He was promoted to Professor of Biblical Criticism in St Andrews University in September 1995 and more recently served as the Vice-Principal for Research. He sat on the board of Scottish Enterprise Fife in a personal capacity from 1999 to 2003. In 1984 he was awarded a Dr Phil from the University of Oxford (Magdalen College). His thesis was in the New Testament area and applied social-scientific ideas to Luke's Gospel and the Acts of the Apostles. He has published very extensively, particularly in the social-scientific analysis of New Testament and other biblical and apocryphal texts and in New Testament theology. He also has a recent monograph in the area of the Bible and the visual arts co-authored with a British artist.

Irwin Feller

Irwin Feller is a senior visiting scientist at the American Association for the Advancement of Science (AAAS) and Professor Emeritus of Economics at the Pennsylvania State University, where he was on the faculty between 1963 and 2002. His research interests include science and technology policy, economics of higher education and program evaluation. His article, "Performance Measurement Redux", American Journal of Evaluation, 23 (2002): 435–452, received the American Society for Public Administration's Joseph S. Wholey Distinguished Scholarship Award and the Best Scholarly Article on Performance-based Governance in 2002). His co-authored study, "A Toolkit for Evaluating Public R&D Investment: Models, Methods, and Findings from ATP's First Decade" (with Connie Chang and Rosalie Ruegg) received the American Evaluation Association's 2004 Outstanding Publication Award.

Robbert Fisher

Robbert Fisher is specialized in strategy and policy in the fields of R&D, technology and innovation. For more then 15 years Robbert has been involved in EU R&TD policy, both as an internal expert and as an external programme, project and policy evaluator and reviewer. He is the project director of the Innovation Impact study, which analyses the innovation outputs of the 5th and 6th Framework Programmes, he was recently involved as manager of several studies that analysed the economic environment and competitiveness of the ICT sector in the EU and its main competitors. Previously, Robbert did a large scale project for one of the top 5 European banks devising their global ecommerce strategy, and wrote the strategic plan for a 500 MEuro investment scheme in the Information Society in Southern Italy, subsequently guiding its' implementation for the Italian Government. He was involved in the EU China action, where he contributed to the awareness and increase of knowledge about IPR on software programmes.

Robbert has been involved in a wide variety of Information Society related studies and services, such as Trust and security projects (such as the BESTS study, FP5CSP, BEE), and copyright related activities (contributor to the EC copyright directive, member of the EC Legal Advisory Board, co-founder and board member of the European Copyright User Platform) always analysing technical, organisational, legal and commercial elements.

From 1989 until 2000 he was a senior manager with PricewaterhouseCoopers where he was responsible for the TechServ office, a dedicated international projects office and team with a staff of 35 focussing on strategy and policy for amongst others the Information Engineering, IMPACT and INFO2000 programmes. From 1991-1995, Robbert was seconded as an expert to the European Commission DG XIII (now DG INFSO) in Luxembourg.

Robbert received a Masters degree in Law, Leiden University, The Netherlands with special subjects Intellectual property, Information Systems and Business economics. He holds degrees in marketing and public relations. In addition he is alumnus of the PwC International Management Development programme, and has followed executive courses at Darden Business School.

Dominique Foray

Prof. Dominique Foray holds the "Chaire en Economie et Management de l'Innovation". He is also the Director of the "Collège du Management et de la Technologie" at the Ecole Polytechnique Fédérale de Lausanne.He is also the Vice Chairman of the expert group "knowledge for growth", a group of prominent economists that has been created by Commissioner J.Potoknic to advise the European Commission.Recently he has been elected to sit at the National Research Council of Switzerland.Previously, he was Research Director at the Centre National de la Recherche Scientifique (CNRS) and Professor at the Institut pour le Management de la Recherche et de l'Innovation (IMRI) of the University of Paris-Dauphine (from 1993 to 2000), and then Principal Analyst at the Organization of Economic Cooperation and Development (OECD) from 2000 to 2004.Prof. Foray's research interests include all topics and issues related to economic policy in the context of the new knowledge-based economy.

Wolfgang Gessner

Wolfgang Gessner studied political science, economics and philosophy in Berlin and Urbino/Italy. His professional experience covers national and European R&D and innovation policy, technology transfer and R&D management. He is also familiar with European public-private partnership models and mechanisms of European Technology Platforms. Since 1989 he is with VDI/VDE-IT where he is dealing primarily with transnational R&D cooperation and innovation support in the field of microsystems technologies. In that context he can rely on a more than fifteen years experience as the manager of technology transfer and innovation support projects, coordinating also the Innovation Relay Centre Northern Germany from its beginning to 2004. In his present position as head of the Dept. Innovation Europe he has started the VDI/VDE-IT's ERA projects. He is responsible for the annual "International Forum on Advances Microsystems for Automotive Applications" and heading the Office of EPoSS, the European Technology Platform on Smart Systems Integration.

Krysztof Gulda

Krzysztof Gulda – has an MSc in Nuclear Physics and Diploma of Postgraduate Study on Intellectual Property at Warsaw University. For 5 years he has been project manager in the University Technology Transfer Centre of Warsaw University responsible for management of business – academia relations and promotion of academic entrepreneurship. Since mid 2003 he is also Director of Innovation Department in the Polish Ministry of Economic Affairs and Labour. He is also the Deputy Director of the Economic Development Department in the Ministry of Economy since February 2006,. Since November 2006 he is the Director of the Economic Development Department in the Ministry of Economy responsible for strategy and programming for innovation, entrepreneurship, IPR, information society and industrial policy.

Ken Guy

Ken Guy operates as a freelance consultant under the umbrella of Wise Guys Ltd., a company he launched in 2000 to conduct innovation policy research and provide advice to policymakers and administrators. He has evaluated policies and programmes in over thirty countries and has been involved in evaluations of many of the European Commission's R&D and innovation programmes. He was Chairman of the Expert Group responsible for the report that underpinned the European Commission's 3% Action Plan for Investing in Research and is currently supporting CREST in the implementation of the plan by reviewing R&D and innovation policy mixes across Europe.

Peter Hahn

Peter Hahn born in 1963 studied Business Administration and Health Care Economy in Berlin .Peter started his professional career in the health care sector with financial controlling, process management and transformation of former GDR health care providers being the main subjects. Interim Management and Business Development for Start ups led to the current activity for VDI/VDE IT. Here his tasks include Quality Management systems and international science-, innovation- and technology co-operations. Peter is Assessor for Award applications to the German national Quality Management Prize, the Ludwig Erhard Prize.

Christopher John Hull

Christopher John Hull is Secretary General of EARTO, the European Association of Research and Technology Organisations. In an earlier career (1974-1986) he worked on the design and evaluation of public programmes in the fields of regional economic development, employment and small firms. During the past 20 years or so he has specialised in European innovation, technology transfer and R&D policies. He has worked as an expert for the European Commission and served as Secretary General of three European trade associations in these areas: TII, FEICRO, and EARTO. He is Chairman of DG Research's Expert Advisory Group on SMEs and a member of Commissioner Potočnik's Sounding Board for Smaller FP Actors. He has also recently acted as rapporteur to two EURAB Working Groups.

Angus Hunter

Angus is the Founder and Managing Director of Optimat; a UK-based strategy consultancy specialising in knowledge-based economic development, sustainable business development and technology commercialisation. He has over 30 years of experience in innovation policy and public R&D programmes from a diverse career in research, industry and regional development before establishing Optimat in 1989. In the UK he has broad practical experience of designing, managing and evaluating research and innovation programmes on a national and regional level. He has also worked on a wide range of European Research Area projects. For example, he has managed one of the ERA-NET Coordination Actions since 2003 and was the lead author of a 2005 study for DG Research on 'Examining the Design of National R&D Programmes'. He is currently a member of the IMPLORE study team that is reviewing national R&D programme strategies related to their impact on innovation.

Markus Koskenlinna

Markus Koskenlinna, Dr Tech, is the executive director of the impact analysis unit in Tekes, the Finnish Funding Agency for Technology and Innovation since 2000. Prior to his present position he was a technology director, assistant director and section chief of process technologies in Tekes, from 1983 to 2000. Between 1977 and 1983 he was a chief inspector in Technology department of Ministry of Trade and Industry. Between 1970 and 1977 he was a teaching assistant and assistant professor in analytical and inorganic chemistry in Helsinki University of Technology. Markus Koskenlinna is a graduate of Helsinki University of Technology, where he received his MSc (Chem. eng.), Lic Tech and Dr Tech.

Georg Licht

Georg Licht is Head of the Department of Industrial Economics and International Management at the Centre for European Economic Research (ZEW) in Mannheim, Germany. He holds this position since June 1994. Before this he was a senior researcher at ZEW and at the University of Augsburg (till 1985). Since 2001 he holds the power of attorney on behalf of the ZEW. He was visiting researcher at the Department of Economics at the Massachusetts Institute of Technology (MIT). He gained his doctoral degree at the University of Augsburg and holds a degree in economics from the University of Heidelberg. His research interests comprise the economics of innovation and technical change, labour economics and High-Tech Start-ups.

He has been engaged in the development of the European Innovation Survey (CIS) and innovation surveys in Germany in the manufacturing and service industries. Various reports to the German government and publications in academic journals resulted from this work. He acted as consultant to OECD's NESTI and TIP group. He was also a member of the OECD working group for the revisions of the OSLO manual. He is a consultant to the OECD, EU-Commission and the German Federal Ministry of Education and Research in the area of innovation and technology policy. In this context he recently co-ordinated a large scale project on the technological competitiveness of Germany and prepared related summary reports to the German research ministry. Currently he is member of Commissioner Janez Potočnik advisory group "Knowledge for growth".

Hans-Peter Lorenzen

Dr. rer. nat. Hans-Peter Lorenzen is board memberof DeGEval – Gesellschaft für Evaluation (Society for Evaluation). He worked with the German Ministry for Economics and Technology and was responsible for innovation and technology policy and for the Ministry for Education and Research in various fields. He studied mathematics, physics and philosophy at the Universities of Hamburg and Heidelberg.

Terttu Luukkonen

Terttu Luukkonen is a Head of the Unit at the Research Institute of the Finnish Economy. She has previously held positions with the Technical Research Centre of Finland (Chief Research Scientist, Director of VTT Group for Technology Studies, 1995-2001) and the Academy of Finland (1974-1995). She is an associate professor at three Finnish universities and has held visiting fellowships in the UK and France.

She has been a member of one of the European Commission benchmarking expert groups (2001), a member of IST 2002 Monitoring Panel, chairperson of the IST First Call Monitoring Panel, and a member of the EU IST 5-Year Assessment Panel in 2004. She has also been a consultant to the OECD, UN ECE and Nordic Council of Ministers, and has been invited to consult or assess science and innovation policies to European governments. She has published widely on research evaluation and science and innovation policies and is on Editorial (Advisory) Boards of several journals in the area, including Research Policy. She holds a Ph.D in sociology of science.

Gerd Meier zu Köcker

Dr. Gerd Meier zu Köcker is the director of the agency "Competence Networks Germany" as well as the Head of Department of the International Technology Cooperation & Cluster within VDI/VDE Innovation + Technik. As a manager of the agency, he is currently responsible for the coordination and support of 120 German Competence Networks.

Furthermore he is responsible for several national and international programmes dealing with innovation and technology development as well as transfers. In the past he was very involved in initiatives aiming to improve the quality and additionality of public funded R&D projects.

Kazuyuki Motohashi

Kazuyuki Motohashi is a Professor at the Department of Technology Management for Innovation (TMI) at the School of Engineering at the University of Tokyo. Until this year he had taken various positions at the Ministry of Economy, Trade and Industry of the Japanese Government. He also worked for the OECD from 1995 to 1998 as an economist in innovation research. His research interest covers a broad range of issues in economic and statistical analysis of innovation, including economic impacts of information technology, international comparison of productivity, national innovation system focusing on science and industry linkages and SME innovation and entrepreneurship policy. Dr. Motohashi was awarded a Master of Engineering from the University of Tokyo, an MBA from Cornell University and Ph.D. in business and commerce from Keio University.

Kjell-Hakan Närfelt

Kjell-Håkan Närfelt has been working with technology driven business development and R&D for more than 20 years. He has a research background in computer science which resulted in an academic spin-off that encouraged him to leave academia and exploit the research results in a commercial context. His recent professional experience includes the position as partner and investment manager at a seed investment company, different management positions within the Telia Group – such as Technical Director at Telia Research AB and as Investment Director at the corporate venture Telia Business Innovation AB. Mr. Närfelt has served as a board member and advisor to several R&D based start-ups and is currently working at VINNOVA as an expert on commercialisation of R&D. Mr Närfelt is also chair of a TAFTIE task force aiming at improving the effectiveness of design, implementation and evaluation of innovation policy measures.

Bart Nooteboom

University Education:

1960-1967 Leyden University, mathematics, Erasmus University Rotterdam: econometrics.

1974-1980 PhD in econometrics at Erasmus University Rotterdam.

1968-70 Military service: development of an automated "war game"

1969-73 Shell International

1970-73: the Hague and London: for example, the development of the Shell approach of scenario planning.

1973-87 Research Institute for Small Business (EIM), the Netherlands:

1973-79: Development of econometric industry models that include firm size effects. 1979-82: Head of the new Dept. of 'Basic Research'. 1982-87: scientific director.

1987-99 University of Groningen: Professor for industrial organization at the School of Management; 1995-99 scientific director of the Ph.D school

1999-2004 Rotterdam School of Management: Professor of organizational dynamics

2004- …. Tilburg University: Professor of innovation policy at the Faculty of Economics and Business Administration.

2006-… Member of the Scientific Council for Government Policy; Project leader for a report on innovation policy.

1999 Elected member of the Royal Netherlands Academy of Arts and Sciences

Dirk Pilat

Head of the Science and Technology Policy Division, Directorate for Science, Technology and Industry Organisation for Economic Co-operation and Development - Mr. Pilat, a Dutch national, began his career in the OECD in 1994 with work in the OECD Economics Department on climate change, unemployment and product market regulation. He joined the Directorate for Science, Technology and Industry in May 1997and has worked primarily on how to strengthen the contribution of science and innovation to economic performance and social outcomes. He became Head of the Science and Technology Policy Division in January 2006 with responsibilities for the OECD's work on science, technology and innovation policy. Mr. Pilat holds a Ph.D in Economics from the University of Groningen in the Netherlands.

Michel Poireau

Born in Paris he is married with two children. After studying in Paris (history, law, political science, Ecole Nationale d'Administration) he worked in a local administration in Southern France and Germany in 1975 and then in various ministries in Paris for 7 years. Since 1984 he has been at the European Commission in Brussels and worked successively in DG INFSO (ex DG XIII), Cabinet Pandolfi and DG-RTD in information technology, telecommunications, aeronautic and energy research. Between 2001 and 2006 he was particularly involved in the strategic aspects of energy research (non nuclear, fission and fusion) and in 2007 he became Head of Unit for Horizontal Issues and Coordination in Industrial Technologies.

Wolfgang Polt

Wolfgang Polt is an economist and has training in organisational development. He is the Head of the Viennese Institute for Technology and Regional Policy of Joanneum Research, a major Austrian public research organisation. He has been involved in major evaluations of research, technology and innovation policies and programmes both on a national and international level and has worked on methodological questions of impact assessment and policy evaluation. Other areas of his research are international comparisons of national innovation systems in the context of the EU (CREST, ERAwatch) and the OECD (country reviews of national innovation systems) as well as analysis and policy consulting on the questions of governance of science, technology and innovation policy. He has been one of the study directors of the INNOVATION IMPACT project and a partner in the IMP-LORE project, which tried to identify the impact of R&D programmes on innovation, the results of which will be presented at this conference.

Luca Alessandro Remotti

Currently Director – Research and Consultancy Services Europe for the Foundation FORMIT - Roma, he has 20 years experience in Technology Evaluation, Research and Technological Development, Technology Transfer, Innovation, Socio-economic Evaluation, Security Systems and Policies. He manages consultancy projects concerning innovative, Information and Communication Technology-based services and is an expert of the analysis and restructuring of processes and of organisations, economic and industrial market analysis and has extensively worked on the design, development and operation of monitoring and evaluation systems. He has specific skills in technological business planning and in the support to management processes for technological innovation in SMEs. He holds a degree in Economics and Business Administration, from LUISS – Roma and a specialisation in economic, financial and organisational management of innovation processes from the CUOA, Vicenza.

Yiannis Spanos

Yiannis E. Spanos is Assistant Professor of Strategic Management at the Department of Management Science and Technology of the Athens University of Economics and Business. His research interests revolve around strategy and competitiveness, innovation and change. His published research has appeared in various academic journals, including the Strategic Management Journal, Information & Management, Journal of Knowledge Management, and the European Management Journal. He is occasional reviewer of Organization Studies, Journal of Management Studies, Journal of Business Venturing, European Journal of Information Systems, International Journal of Entrepreneurship and Innovation Management, and Cahier du Management Technologique. He is also member of the Editorial Board in Organization Studies and International Journal of Business Environment. In addition, Dr. Spanos is an external advisor to the Hellenic Innovation Relay Center since 1997.

Jörg Michael Thielges

Jörg Michael Thielges is a management consultant since 2006 focusing on innovation and corporate strategies. Until then he worked for 37 years for IBM as Director Large System Development and Director Business Software Development in IBM laboratories in Germany and the USA among others. He always kept close relations to key customers, the media, politicians and universities in order to translate their needs into innovative products, processes and services and share with them his view of current and future IT technologies. Jörg was a member of the managing board of the German Information Technology Society with 11.000 members thereof 3 years as it's head.

Jan j. H. van den Biesen

Educated as a physicist at Leiden University, Jan van den Biesen spent one year as a post doctoral candidate at the University of California in Berkeley before joining Philips in 1983 to work on semiconductor research. After a one-year secondment to Hitachi's Central Research Laboratory in Tokyo in 1986/7, he held various R&D-related staff positions within Philips Research and Corporate Headquarters. In the mean time, he complemented his education with an MBA. As Vice President Public R&D Programmes of Philips Research he coordinates Philips' participation in public programmes for R&D partnerships in Europe. In addition, he represents Philips' R&D interests with public authorities in Europe. In this context he is a regular speaker at conferences and hearings and the chair of or an active member in various working groups, task forces and expert panels.

Dr. John van den Elst

Dr. John van den Elst is Manager of the Digital Systems & Technologies Department in Eindhoven of Philips Applied Technologies. He obtained a Ph.D at INRIA Sophia Antipolis (France), a Masters degree at the University of Amsterdam (The Netherlands) and an MBA at the University of Uppsala (Sweden). John is married and has two children.

Jacques van der Meer

Jacques van der Meer works as deputy economic adviser at the European Investment Bank's Project Directorate where he is in charge of the appraisal of industrial R&D projects. His interest in Intellectual Capital and R&D dates back to his Ph.D.(1987) which addressed the key issues for successful R&D- and innovation strategies in the semiconductor and pharmaceutical industries. Before joining the EIB in 1991, Jacques van der Meer lectured Strategic Management at the Rotterdam School of Management of the Erasmus University (his alma mater) and the Ecole Superieure de Commerce in Lyon (known now as the EM de Lyon).

Pierre Vigier

Pierre VIGIER is a specialist in European affairs, in particular for industry and innovation. He began his career in France (1981-1987) within a number of ministerial cabinet offices and at the Territory Planning Agency (DATAR). He was responsible for Integrated Regional Development Programmes for the South of France and for the preparation of the French Motorway Plan 1988-2003. In 1988, he joined the European Commission with responsibilities in automobile industrial affairs, where he notably negotiated the commercial agreement between Japan and the European Union in the automobile sector (1991-2000) and followed the restructuring of large European groups in that sector. He subsequently coordinated Industrial cooperation of the EU with Asia. As a member of the Cabinet for the Commissioner in charge of Science, R&D, Innovation, Education, Training and Youth (1995-1999), he launched the 1995 green paper on Innovation in Europe, and was responsible for the industrial research and space policy (Galileo, GMES, etc.). Since his return at the end of 1999 to Enterprise and Industry Directorate-General in the European Commission, he has presided over the creation of the Enterprise Policy Group, the extension of the European Charter on Small Businesses and the drafting of the new European SME definition. Since April 2003, he holds responsibility on the interface between Research and Industry, notably on technology platforms and on strategic aspects of innovation policy such as the European Institute of Technology, the Lead Market Initiative, Cluster Policy or State Aid issues. He is a graduate in Law and holds Masters Degrees in both Economics and Politics from the Ecole Supérieure des Sciences Economiques et Commerciales and from the Institut des Sciences Politiques de Paris. He has written numerous articles, reports, publications, and works on the European monetary system, the single market, the institutional and political future of Europe, the competitiveness of the automobile industry, industrial policy, the economic dialogue between Europe and Japan, European innovation policy, space policy, the aeronautical industry, European Enterprise policy, the SME Definition, etc.

Michael vom Baur

Michael vom Baur is graduated Naval Architect. After 5 years of technical tasks since 1986 he works since 1986 in different management positions in ship building and engineering & construction. Today he is Senior Vice President in the Group Management of Aker Yards ASA, one of Europe's largest shipbuilders responsible for the LNG business. He has broad experience as a coordinator of R&D projects and being the Group Head of R&D as well as is the Chairman of the European Shipbuilders Association CESA's permanent R&D Committee (COREDES) since 2003 as well as Secretary of the WATERBORNE Technology Platform.

Nicholas S. Vonortas

Professor Vonortas joined the Department of Economics as an assistant professor in 1990. He became an Associate Professor in 1996. He received his Ph.D. from New York University in 1989, his M.A. from Leicester University (UK) in 1983 and his B.A. from Athens University (Greece) in 1981. At GW he holds a joint appointment with the Center for International Science and Technology Policy. His research interests are in industrial organization, the economics of technological change, and technology and competitiveness. A significant part of his research has been on research joint ventures and other forms of inter-firm strategic alliances and on technology transfer.

Torbjörn Winqvist

Torbjörn Winquist is head of the evaluation unit of the Swedish Agency for Innovation Systems (VINNOVA). He has long experience with regard to the evaluation of R&D programmes in Sweden.