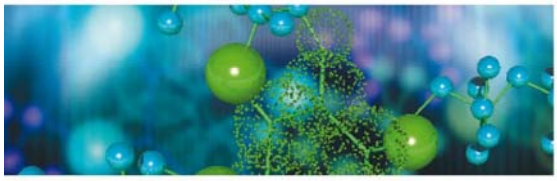

November 2007

Operations Evaluation

Evaluation of i2i Research, Development and Innovation (RDI) projects

Synthesis Report

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GLOSSARY

GLOSSARY OF TERMS AND ABBREVIATIONS

AGI	Action for Growth Instruments
ASAP	Amsterdam Special Action Programme
Borrower	The legal *persona* with whom the Bank signs a Loan Agreement.
bp	basis points (one hundredth of one percent interest)
CA	EIB's Board (*q.v.*) The EIB Board of Directors, which has sole power to take decisions in respect of loans, guarantees and borrowings.
CD	EIB's Management Committee (*q.v.*)
COP	Corporate Operational Plan
ECOFIN	EU Economic and Financial Affairs Council
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIF	European Investment Fund, part of EIB Group
EIRR	Economic Internal Rate of Return
EU	European Union
EV	EIB Operations Evaluation (Ex-Post)
FIRR	Financial Internal Rate of Return
FVA	Financial Value Added
GDP	Gross Domestic Product
GED	Gestion Ēlectronique Documents (Electronic Documents and Records Management System)
i2i	Innovation 2000 Initiative (Innovation 2010 Initiative from March 2003)
ICT	Information and Communications Technology
Lisbon process	Throughout this report the phrase 'Lisbon process' will be used to refer to the ongoing process launched at the Lisbon European Council in March 2000 that set a new strategic goal for the EU to become 'the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.' Also referred to as the Lisbon Strategy and the Lisbon Agenda.
Management Committee	Internal EIB committee, comprising the Bank's President and Vice-Presidents
NACE	"Nomenclature générale des Activités économiques dans les Communautés Européennes" is the European classification of economic activities and provides a reference framework for the production and the dissemination of statistics related to economic activities. The latest revision (Rev 2) was adopted in 2006 for use throughout the EU. The EIB uses a sector classification system based on NACE.
OECD	Organisation for Economic Cooperation and Development
Ops-A	EIB Directorate for Lending Operations – EU Members, Acceding, Accession and Candidate States
PCR	Project completion report
PJ	EIB ProJects Directorate – Responsible for *ex-ante* project techno-economic analyses, the preparation of the Technical Description, and the physical monitoring of implementation and completion.

Project	A clearly defined investment, typically in physical assets, e.g. a specific section of road, a bridge, etc.
Project Pipeline	Those projects which have been signalled to the Bank, but have either not yet been approved by the Management Committee, or have been approved but not yet signed. These include projects under active appraisal and those in the process of contract negotiation prior to signature.
Promoter	Normally the *persona* responsible for identifying and developing a project. The promoter may also be responsible for operating and/or implementing the project.
R&D	Those activities which meet the accountancy/statistical definition of research and development, and which include much, but not all, of the innovation cycle.
RDI	The acronym RDI (Research Development and Innovation) is used throughout this report to refer to the EIB lending priority 'R&D and innovative downstream investment, notably in the private sector'. RDI refers to the whole process of generating new knowledge and turning it into productive economic activity and is slightly wider definition than R&D.
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RM	EIB Risk Management Directorate, responsible for credit appraisal and portfolio management
RSFF	Joint EIB/Commission Risk Sharing Finance Facility
SFF	EIB Structured Finance Facility
SME	Small or medium sized Enterprise. A company with less than 250 employees.
SPV	Special Purpose Vehicle – A company, with its own legal *persona*, set up for a limited set of specific purposes, e.g. to borrow for the construction of a project.
TA	Technical Assistance
Technical Description	Project definition - the basis of the Loan Agreement; prepared by PJ.
VA	Value Added

EXECUTIVE SUMMARY

Introduction

This ex-post evaluation deals with EIB financing of selected projects in the fields of research, development and innovation under the Innovation 2000 Initiative (i2i)[1]. It covers the period between the i2i launch in 2000 up to December 2006 and is the first ex-post evaluation of RDI projects to be conducted in this policy area. Global loan operations are not included, nor are EIF operations in support of RDI. The focus of the evaluation is on the relevance and performance of the projects, using the internationally accepted evaluation criteria, together with the EIB's contribution to and performance in these projects. Whilst all of the Bank's priorities are considered, a particular assessment was made of the extent of the impact of the RDI aspects of each project and therefore their contribution to the Lisbon process[2].

The acronym RDI (Research Development and Innovation) has become shorthand for one of the three lending priorities of the EIB under i2i; 'research & development and innovative downstream investment (products and processes), notably in the private sector'. RDI therefore encompasses more than research & development; it includes the transformation of new knowledge into productive economic activity. For the purposes of this evaluation a simple classification was adopted as a means of establishing a common vocabulary to describe the wide range of EIB activity under RDI. The resulting ten point 'RDI Scale'[3] is used to describe the whole process from discovering or creating new knowledge through to its productive application in new or improved services, products and processes.

EIB lending under the i2i policy is split into three priority areas; Education, ICT and RDI. Between 2000 and 2006, the Bank signed a total of EUR 46.1bn of loans under the i2i priority, of which RDI signatures accounted for EUR 23.0bn. A total of 122 RDI projects, or around 50% of total i2i activity, were signed during this period, the remaining half being divided almost equally between Education and ICT. An examination of the distribution of signatures among countries shows that the highest volumes are in Germany (42.2%). Five other EU15 countries have approximately 6 to 8% each, and the rest share the remaining 21.4 %, with no other country exceeding 4% individually. Of the new member states, only Poland (6%) attracted a significant share of RDI lending over the evaluation period.

Policy Context/Relevance

The European Council held a special meeting in Lisbon in March 2000 to agree a new strategic goal for the Union in order to strengthen employment, economic reform and social cohesion as part of a knowledge-based economy.

> "The Union has today set itself a new strategic goal for the next decade: *to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*

In order to achieve this goal, a three-pronged strategy was proposed:

- preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D, as well as by stepping up the process of structural reform for competitiveness and innovation and by completing the internal market;
- modernising the European social model, investing in people and combating social exclusion;
- sustaining the healthy economic outlook and favourable growth prospects by applying an appropriate macro-economic policy mix.

One of the key areas of intervention envisaged was the establishment of a "European Area of Research and Innovation".

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1 Reviewed and expanded as the Innovation 2010 Initiative in April 2003, following the decisions of the Barcelona (2002) and Brussels (2003) summits. With its i2010i programme the Bank extended and fine-tuned its support to the Lisbon process by adding innovation projects to its list of priorities.

2 Throughout this report the phrase 'Lisbon process' will be used to refer to the ongoing process launched at the Lisbon European Council in March 2000 that set a new strategic goal for the EU to become 'the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.'

3 See explanation in §1 and Appendix 1.

Although the strategic goal set at Lisbon was clear, and has remained constant throughout the evaluation period, the same cannot be said of the intermediate and lower objectives, which from the outset engendered a certain lack of clarity with respect to scope and priorities. When then compounded by a process of continual addition and adjustment, the resulting policy roadmap becomes difficult to follow.

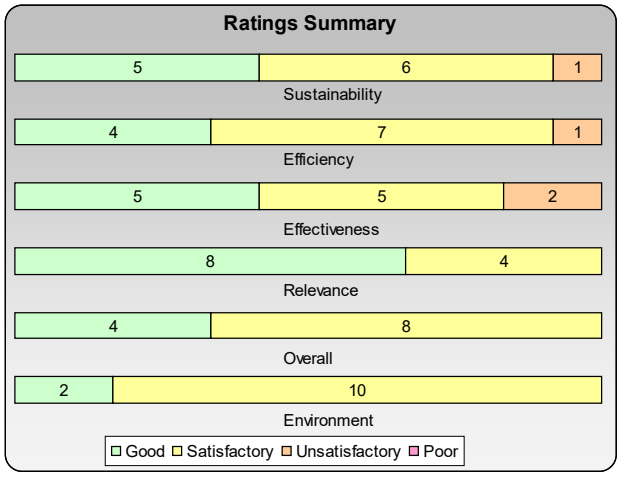
The widely varying country performance reflected in OECD surveys, together with the uneven distribution in the EIB lending portfolio, suggest that any action in this lending area should have a strong country-specific element. From the outset the Lisbon process has stressed the importance of social cohesion and since RDI tends to concentrate in more developed economies this might imply, for example, increased activity in education and ICT for those countries with less developed RDI. This would allow a better distribution of i2i activity amongst countries.

All projects evaluated were relevant to the general Lisbon process, although some only partially contributed. Many of the projects examined also addressed other priority lending areas at the same time, especially regional development, environment, and human capital (education). Overall, no project was rated as less than satisfactory. Given the rapidly evolving policy framework within this period, this can be considered as a significant achievement.

It appears that the Bank's intervention in the private sector, perhaps due to the nature of the companies' field of activity, was more orientated towards projects which are at the 'Innovation' end of the RDI scale and in only two cases were the beneficiary of the project SMEs. There also appears to be a significant under representation of activities in the middle of the scale.

Project performance

Operations were evaluated on the basis of internationally accepted evaluation criteria of Relevance, Effectiveness, Efficiency and Sustainability. A summary of the ratings achieved is given below. These include a separate rating for Environment, although this aspect is already considered under the four main evaluation criteria.



Physical projects were generally completed on time and within budget, with the exception of one project where costs were similar but the scope was considerably reduced, and another where significant cost overruns were incurred overcoming implementation problems resulting from the innovative nature of the process. The fast moving nature of technological innovation also tended to be reflected in management structures. Five of the projects underwent changes of management as a result of changing company structures. One further public sector project was also subject to substantial political change during the implementation period. However, all of the operations visited during the evaluation were technically sound, functional and in good condition and the management considered appropriate.

Generally the EIB uses the rate of return of a project as the main measure of its efficiency, and this was used for projects which lent themselves to this approach. However, for this evaluation a different approach has been developed to reflect the more intangible nature of some of the investments and the position of the project on the RDI scale. All but one project had a positive rating for the efficiency criteria. This is considered to be a particularly good result given the wide scope of the subject, its constantly evolving policy framework and the lack of a unified approach to project definition and

selection. The Bank's ex ante project selection and evaluation process varied considerably to take account of the nature of the projects, and a certain lack of consistency in approach and in choosing key variables was therefore inevitable. The project rated unsatisfactory was a less well developed public sector research programme.

In all of the cases examined, the promoters' technical and managerial/operational capacity to adequately maintain the projects' assets was not in doubt and the distinguishing risk factors were largely generic industry related. The sustainability of all projects except one was therefore rated as satisfactory or better. Four projects involved the research programmes of medium sized companies with strong market positions. Two projects represented support for public tertiary education research systems whose longer term funding was considered secure. One project was considered to be at risk of production relocation to lower cost locations and was rated unsatisfactory.

In the course of the approval process, all projects are subject to an environmental review, in which compliance with local, state and federal law is verified and all relevant permits were obtained. It was also ascertained that all practices used by the companies regarding the disposal of waste and hazardous materials complied with national legislation and international standards. No project evaluated ex-post raised concerns from this point of view. However, the support of projects at the frontiers of science pose a particular issue for the Bank in terms of environmental and social assessment which goes beyond the question of strict regulatory compliance.

The overall ratings confirm that the Bank is financing projects that are performing well. Relative deficiencies linked to cost overruns and delays, partial non-achievement of initial objectives are counterbalanced by other positive aspects of the projects.

EIB contribution and project-cycle management

Ex post, the Bank's main strength in the projects evaluated resided in its role of providing large financial resources in tune with the needs of the promoter and at competitive rates and terms, although there was also an important non-financial contribution for some projects. Overall, four projects were rated high. These were generally where both financial and non-financial contributions were important, or cases where the Bank provided a strong signalling effect. In the other cases, the projects benefited mainly from significantly better financial terms than the alternative funding available. One case was rated as moderate, since the promoter was a large company with ready access to alternative sources of funding. Overall, the Bank's financial contribution was helpful but not critical.

EIB project cycle management has been perfected over a long period of time and is systematic, structured and well adapted to the vast majority of the Bank's operations. The intangible nature of some RDI investments, together with the uncertainty of their outcome, pose particular challenges for the ex ante appraisal, implementation monitoring and ex post evaluation of RDI projects. The projects examined were all managed in a satisfactory way, but there was some evidence that this was a result of ad hoc adaptation of established procedures and methods in response to RDI as a relatively new area of operation. Whilst the (successful) result is a credit to the professionalism of the staff involved, there is now a need for a more systematic review of the appropriateness of the Bank's established project-cycle management for RDI projects.

TABLE OF RECOMMENDATIONS

	EV Observations & Recommendations	Response of the Operational Departments
1.	**Observation:** The widely varying country performance reflected in OECD surveys, together with the uneven distribution in the EIB RDI lending portfolio, suggest that any action should have a strong country-specific element (§3.2). This could be considered at the level of the i2i priority and not just at the level of RDI activity. **Recommendation:** RDI lending should continue with its existing focus on high quality private sector driven research, but, in addition, the EIB should develop a country-specific approach for countries whose technical development is lagging behind. This might for example involve more focus on education, public sector R&D, or technology start-up companies in these countries.	The forthcoming review of i2i (whose EUR 50 bn target has been reached in 2007) will provide an opportunity to reflect on this recommendation and to highlight the Bank's possibility to further support Member State efforts.
2.	**Observation:** It appears that the Bank's intervention in the private sector, perhaps due to the nature of the companies' field of activity, was more orientated towards projects which are at the innovation end of the RDI scale, and in only two cases were the beneficiary of the project SMEs (§3.4). **Recommendation:** Whilst continuing with existing activities, the Bank should seek, in addition, to strengthen its intervention in segments of the innovation cycle where it is currently under represented and where the added value of its operations could be higher still.	RSFF, launched by EIB and the European Commission in June 2007, will enable support of earlier stages of the innovation cycle as well as smaller companies (including SMEs). Some of the financial instruments available at EIF, part of EIB Group, in particular venture capital would appear better suited to support the early stages of the innovation cycle including technology transfers from universities. The Bank's services are increasingly focusing on operations with higher Value Added.
3.	**Observation:** The projects examined were all managed in a satisfactory way, but there was some evidence that this was a result of ad hoc adaptation of existing procedures and methods in response to RDI as a relatively new area of operation. A number of minor issues were noted (§2, §4.2, §4.4, §6.2, §6.4) which were not significant in themselves. **Recommendation:** A review should be carried out of the appropriateness of the Bank's established procedures to RDI projects.	At the launch of the i2i programme in 2000, the procedures and methodologies applied were based on the appraisal of a small number of RDI projects. Since then, both have been further developed and refined with a view to establish a coherent approach to RDI projects. Guidelines for the appraisal of RDI projects will be prepared by the end of 2007.

1. INTRODUCTION

This ex-post evaluation deals with EIB financing of selected projects under the R&D priority of the Innovation 2000 Initiative (until April 2003) and under the extended Research Development and Innovation (RDI) priority of the Innovation 2010 Initiative (since April 2003). It covers the period between its launch in 2000 up to December 2006 and is the first ex-post evaluation to be conducted in this policy area. Global loan operations are not included, nor are EIF operations in support of RDI. The focus of the evaluation is on the relevance and performance of the projects, as well as EIB's contribution and performance in these projects. Whilst all of the Bank's priorities are considered, a particular assessment was made of the extent of the impact of the RDI aspects of each project and therefore their contribution to the Lisbon process[4].

The evaluation has two primary functions. Firstly, to increase transparency to the EIB's governing bodies and, secondly, as a learning exercise to provide assistance to the Bank's operational departments, thereby increasing the Bank's value added in future operations. This report does not represent an evaluation of the overall i2i policy or of the Lisbon process itself.

What is RDI?

The acronym RDI (Research Development and Innovation) has become shorthand for one of the three lending priorities of the EIB under the i2i policy; 'research & development and innovative downstream investment (products and processes), notably in the private sector'. RDI therefore encompasses more than research & development (R&D); it includes the transformation of new knowledge into productive economic activity. This is an important distinction when comparing RDI (EIB policy) with R&D (statistical definition with marginally smaller scope).

The boundaries between education, RDI and production are difficult to define, but are none the less important for the collection of statistics, the publication of accounts and the definition of state aid. The resulting definitions have been adopted by the EIB but are necessarily complex, requiring a high degree of data disaggregation to apply (see Appendix 2 for a fuller discussion). For the purposes of this evaluation a simpler classification was adopted as a means of establishing a common vocabulary to describe the wide range of EIB activity under RDI. The resulting ten point 'RDI Scale' is shown opposite and is used consistently in this report to describe the whole process from discovering or creating new knowledge through to its productive application in new or improved services, products and processes across a wide range of sectors and industries. On this scale, the more commonly used term R&D would stretch from 1 to the middle of 8.

Innovation Cycle	RDI Scale	
	Stage	Description
Research	1	Intellectually-driven investigation with no foreseeable economic application.
	2	Investigation within established disciplines/technologies.
	3	Applied research within existing technology boundary with practical applications in mind.
Development	4	Technology 'start-up' to develop practical applications for research ideas.
	5	Collaborative development within existing industries to produce new or next generation technology.
	6	Technical development of products following a defined longer-term technology 'roadmap'.
Innovation	7	Development of 'new generation' products involving substantial modification/innovation.
	8	Process/product innovation designed to modify/improve/differentiate existing products.
	9	Process innovation designed to reduce cost or extend life of existing product range.
Not RDI	10	Investment in maintenance or expansion of existing production.

The process of discovering or creating new knowledge, of developing it into new economic activities, which then in turn spin off new knowledge and new ideas that start the process all over again, is generally referred to as the Innovation Cycle. RDI can be considered to be the three constituent parts of the Innovation Cycle: research, development and innovation. The definitions of these stages vary, but for the purposes of this evaluation 'Research' is considered to be the curiosity-driven process of discovering new knowledge. 'Development' is the deepening of new knowledge with a view to

[4] Throughout this report the phrase 'Lisbon process' will be used to refer to the ongoing process launched at the Lisbon European Council in March 2000 that set a new strategic goal for the EU to become 'the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.'

developing a practical application, and 'Innovation' is the process of using new knowledge to improve existing applications. When describing the Innovation Cycle it is important to remember that any linear description of the process is a simplification.

By supporting research, development and innovation activities (RDI), the EIB is therefore intervening in the Innovation Cycle with a view to increasing the stock of knowledge (human capital) and generating productive economic activity.

Approach and methodology[5]

The comparison of ex-post results with the expectations and objectives at appraisal is the main basis for the evaluation of the operations. In accordance with the Bank's evaluation procedures, individual projects were rated according to four categories: "Good", "Satisfactory", "Unsatisfactory" and "Poor"[6]. The evaluation was carried out by internal EV staff and the relevant operational departments (OPS-A, PJ and RM) were consulted at the various stages of the evaluation. The following steps are key elements for this evaluation:

A general review of EU, Member State and EIB policies and strategies, informed by a discussion paper based on a literature review of work related to the evaluation and appraisal of intangible investments.

A comprehensive portfolio review - analysing EIB financing trends, sector and country distributions for 122 i2i RDI projects signed during the period 2000 to 2006.

A project completion report review - based on an analysis of 25 new format Project Completion Reports (PCRs) issued by PJ out of the 122 projects signed during the period between 2000 and 2006.

A desk review - of an initial sample of 19 out of 37 projects eligible for evaluation[7] was carried out, which formed the basis for the selection of the final project sample. On the basis of the desk review findings 12 projects[8] were chosen for in-depth evaluation as representing a good selection in terms of country coverage, loan volume, promoter type, sector, size and type of operation.

The resulting project sample is representative for the RDI financing of the Bank during the period 2000 to 2006. The following table summarises the main features of the selected projects, covering 8 EU Member States.

No.	Sector	RDI Stage	Size*	Promoter
1	Manufacturing – IT	7	Small	Private
2	Manufacturing – Biotech	3/6/8	Medium	Private
3	Manufacturing – Paper	8	Medium	Private
4	R&D Infrastructure	4/5	Small	Private
5	Electricity/Gas/Water	8	Large	Private
6	Manufacturing – Pharmaceuticals	3/6/8	Medium	Private
7	Manufacturing – IT	9	Large	Private
8	R&D	2	Large	Public
9	Manufacturing – Miscellaneous	3/6/8	Medium	Private
10	Manufacturing – Iron and Steel	6	Small	Private
11	Education	2	Large	Public
12	Manufacturing - IT	8	Medium	Private

* Loan size – small <100 million, large >250 million.

In-depth evaluation & synthesis: During the last step, detailed project analysis and field visits for all projects have been conducted. Individual evaluations involved meetings with the organisations for project implementation, operation and policy. Site visits included meetings with responsible company managers, representatives from national, local and regional authorities and academia. Individual evaluation reports have been prepared and discussed with the operational staff associated with the

5 See also Appendix 1

6 "High", "Significant", "Moderate" and "Low" for EIB contribution.

7 For the purposes of this evaluation, projects with a completion date earlier than 31.12.2006 (as at March 2007) were considered to be potentially eligible for evaluation.

8 Project number 5 also formed part of the Evaluation of Economic and Social Cohesion: Operations in Germany, Ireland and Spain. Project number 9 was a combination of two individual EIB operations.

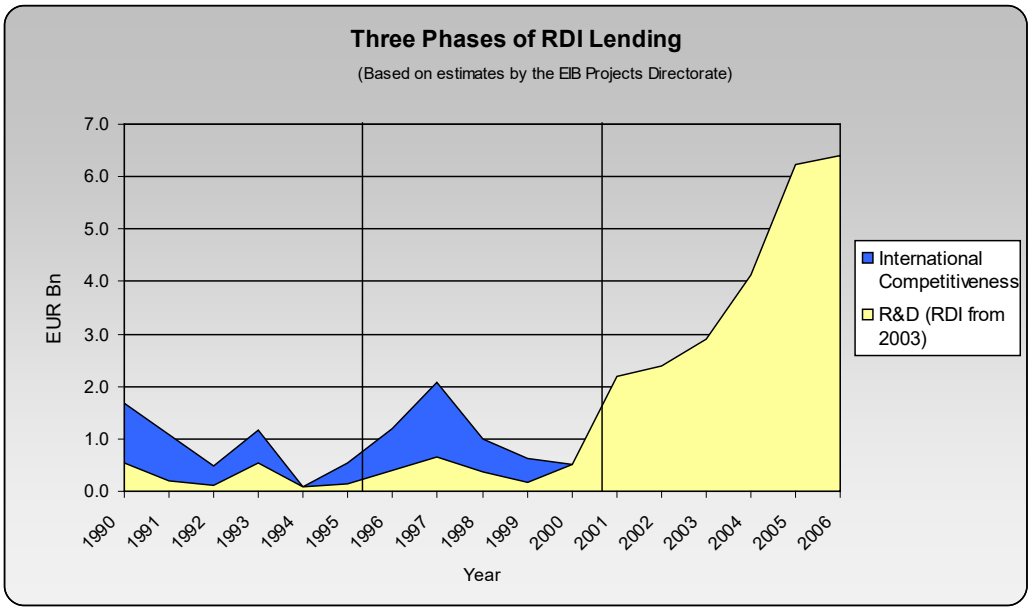
project, and the main elements were provided to project promoters for their comments. The information contained in these reports is of a confidential nature and availability is restricted to EIB staff.

This evaluation report is a synthesis of the findings of the individual evaluations and the complementary analysis and considers a total of 29[9] projects for its conclusions, representing 24% of projects signed during the period 2000 to 2006. Of the projects completed during this period, 35% were the subject of in-depth evaluation.

2. BACKGROUND

The origins of EIB involvement in RDI

The EIB has been funding investments in research and innovation for over thirty years. This was initially within the context of other eligibility criterion such as Regional Development, Advanced Technology and International Competitiveness.



This historical involvement may be split into three phases:

1970 – 1994 Funding within the context of Regional Development, Advanced Technology and International Competitiveness. The funds themselves appear to have been used mainly for R&D infrastructure, rather than intangible assets.

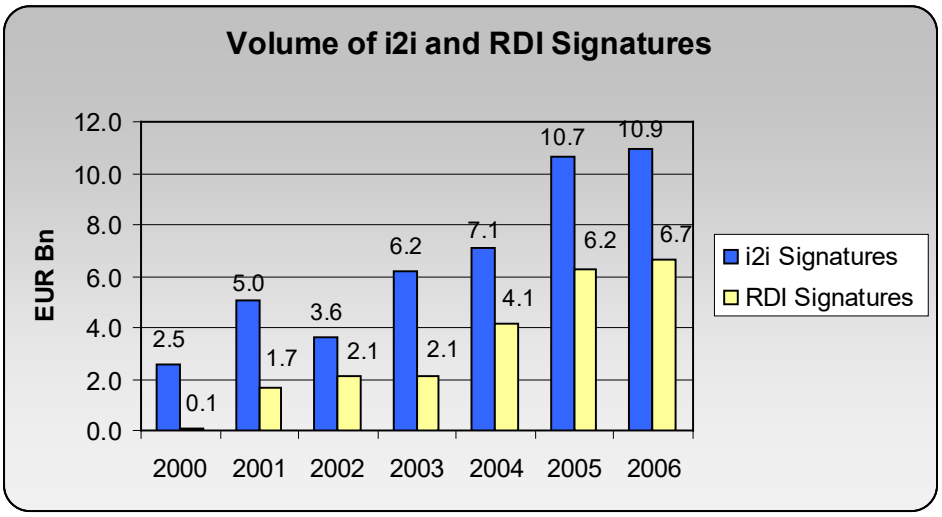
1995 – 1999 In June 1995, Research & Development became an eligibility criterion in its own right, provided that the anticipated end-results would give rise to an industrial application or would be marketed without delay. International Competitiveness eligibility included project elements which would now be described as innovation. Lending volumes were relatively low and, again, most of the funding went to physical assets.

2000-Present In 2000, the EU launched what has become known as the Lisbon process, aimed at making the EU the most competitive knowledge-based economy in the world. The EIB response was the "Innovation 2000 Initiative" (i2i) which initially promised a dedicated lending programme of EUR 12 to 15bn over three years. The initiative was refined and expanded in 2003, with RDI being one of three core lending objectives. A further envelope of EUR 20bn was made available for the years 2003-2006. (Up until 2003, R&D was still financed under the "International Competitiveness" eligibility).

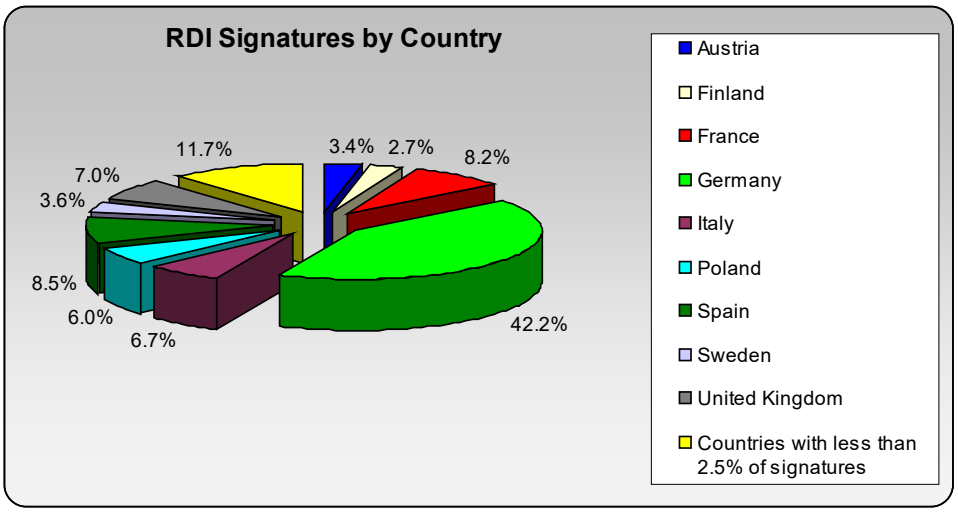
[9] 12 projects (13 operations) examined in depth together with 17 PCR reviews of RDI projects signed between 2000 and 2006 not already considered in depth.

Presentation of the EIB RDI portfolio 2000 – 2006

EIB lending under the i2i policy is split into three priority areas: Education, ICT and RDI. Between 2000 and 2006, the Bank signed a total of EUR 46.1bn of loans in the i2i sector, of which RDI signatures accounted for EUR 23.0 bn. A total of 122 RDI projects, or around 50% of total i2i activity, were signed during this period. The following chart illustrates the relative importance of RDI and the other components of i2i in terms of billions of Euro signed. RDI has the highest share of activity, the remaining half being divided almost equally between Education and ICT. Two projects were financed under the Bank's Structured Finance Facility.



An examination of the distribution of signatures among countries shows that the highest volumes are in Germany (42.2%). Five other EU15 countries have approximately 6 to 8% each, and the rest share the remaining 21.4 %, with no other country exceeding 4% individually. Of the new member states, only Poland (6%) attracted a significant share of RDI lending over the evaluation period.



Given these findings, the EIB project pipeline (as at March 2007) was also examined. Whilst the relative proportions vary and the predominance of German projects decreases, the same broad conclusion can be drawn that RDI lending is and is likely to remain focused on the higher income member states, where most RDI occurs.

No significant conclusions were drawn from the analysis of lending by sector, where Manufacturing was the largest. However, it was noted that the NACE[10] codes were particularly difficult to apply in relation to research and development activities as these activities are not sector-specific.

3. POLICIES & STRATEGIES – RELEVANCE

RELEVANCE *is the extent to which the project objectives are consistent with EU policies, the decisions of the EIB Governors, as well as the country policies. This chapter examines the key elements of these in turn before outlining the performance of the project sample.*

3.1 EU POLICIES AND OBJECTIVES

The origins of EU policy and cooperation in research, development and innovation go back to the European Coal and Steel Community (ECSC), founded in 1952 in order to pool the resources and knowledge of these two strategic sectors, and provide supra-national control of their activities, including research and development. This was followed by the creation of initiatives such as EURATOM, the Joint Research Centre and EUREKA. During the 80s the European Commission introduced the multi annual framework programmes for research and technical development. These have embodied different policy priorities and changing perspectives and have become more complex and sector specific over time[11].

The Maastricht Treaty, signed in 1992, provided a legal base for the promotion of all research activities at the EU level.

"The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other chapters of this Treaty."

The following policy analysis focuses on policy development during the period under evaluation, beginning with the Lisbon process in 2000.

3.1.1 The Lisbon Process

The European Council held a special meeting in Lisbon in March 2000 to agree a new strategic goal for the Union in order to strengthen employment, economic reform and social cohesion as part of a knowledge-based economy.

"The Union has today set itself a new strategic goal for the next decade: *to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*

In order to achieve this goal, a three-pronged strategy was proposed:

- preparing the transition to a knowledge-based economy and society by better policies for the information society and R&D, as well as by stepping up the process of structural reform for competitiveness and innovation and by completing the internal market;
- modernising the European social model, investing in people and combating social exclusion;
- sustaining the healthy economic outlook and favourable growth prospects by applying an appropriate macro-economic policy mix.

One of the key areas of intervention envisaged was the establishment of a "European Area of Research and Innovation".

[10] "Nomenclature générale des Activités économiques dans les Communautés Européennes" is the European classification of economic activities. The EIB uses a sector classification system based on NACE.

[11] FP5 1998-02 (EUR 13.7 bn), FP6 2002-06 (EUR 17.5 bn), FP7 2007-13 (EUR 53.2 bn)

The EIB was also called upon to intervene in specific areas:

- the Community and the Member States, **with the support of the EIB**, to make available in all European countries low cost, high-speed interconnected networks for Internet access and foster the development of state-of-the-art information technology and other telecom networks as well as the content for those networks

- improve the environment for private research investment, R&D partnerships and high technology start-ups, by using tax policies, venture capital **and EIB support**

- facilitate the creation by the end of 2001 of a very high-speed trans European network for electronic scientific communications, **with EIB support**, linking research institutions and universities, as well as scientific libraries, scientific centres and, progressively, schools

- the Council and the Commission to report by the end of 2000 on the ongoing review of EIB and EIF financial instruments in order to redirect funding towards support for business start-ups, high-tech firms and micro-enterprises, as well as other **risk-capital initiatives proposed by the EIB.**

Case Study – Project 7 (Hi-tech Cluster)

The project was one of a series of EIB investments made during a 15 year period and involved the construction and installation of the next generation of manufacturing facility. The project followed on from the successful completion of a pilot plant for the new process (also supported by the EIB) produced by a joint venture between local companies and the public sector. The new manufacturing process required substantial investment in research and specialised equipment and its scaling up to full production involved additional process innovation. Although the industry is particularly volatile, EIB involvement has helped to build a strong regional cluster that will be resistant to industry pressure to relocate manufacturing to cheaper locations and successfully combines RDI and Cohesion objectives.

The European Council was to ensure more coherent strategic direction and effective monitoring of progress using a new "open method of coordination". This took the form of the monitoring and publication of key innovation indicators on a country by country basis.

Although the objectives set at the Lisbon council remained at the core of the Lisbon process, subsequent Council meetings, in pursuance of their strategic guidance role, added successive layers to the process. The most significant of these were the Barcelona Council in March 2002, which added a specific target for R&D spending of 3% of GDP by 2010, the Brussels Council of December 2003 which launched the European Action for Growth initiative, and the Brussels Council of March 2005 which re-launched the Lisbon process for the second half of the decade, as well as calling on the EIB to *"extend its Structured Finance facility to R&D projects and, together with the Commission, explore new ways of using community funds as levers for EIB loans"*. In response, the Commission and the EIB also jointly designed a Risk Sharing Finance Facility (RSFF) to finance investments in high-risk research, technological development and demonstration projects through loans and guarantees.

Therefore, although the strategic goal set at Lisbon was clear, and has remained constant throughout the evaluation period, the same cannot be said of the intermediate and lower objectives, which from the outset engendered a certain lack of clarity with respect to scope and priorities. When then compounded by a process of continual addition and adjustment, the resulting policy roadmap becomes difficult to follow.

3.1.2 The Role of the Commission

During the same period, the European Commission produced a series of communications on policy in this area[12], but its main instrument of intervention is the Framework Programme for Research and Technological Development.

The period of the evaluation was covered by both the fifth framework (FP5), covering the period to 2002, and the sixth framework (FP6), covering the period 2002 to 2006, with a budget of EUR 17.5 bn. The latter was designed with the Lisbon process in mind and its main theme was to assist in the creation of a European Research Area. It represented around 4% of total EU spending on R&D for the period.

The seventh framework (FP7) was recently approved for the period 2007-2013 with a significantly enhanced budget over FP6 and introduced Joint Technology Initiatives (JTIs), a new funding scheme under which particularly ambitious research and technology agendas will be realised at European level in priority areas such as fuel cells and nano-technology, that will according to the Commission "*accelerate the generation of new knowledge, enhance the uptake of the results of research into strategic technologies and foster the necessary specialization in high technology sectors which determine the EU future industrial competitiveness"*.

The 2007-2013 programming period will also see the launch of the first "Competitiveness and Innovation Framework Programme (CIP)", a complementary response to the Seventh Framework Programme that is aimed at pursuing the objectives of the renewed Lisbon process. The CIP has identified three main areas of activities: Entrepreneurship and Innovation Programme, ICT Policy Support Programme, Intelligent Energy-Europe Programme. The aim of the CIP is to help SMEs to increase their competitiveness and to foster eco-compatible innovation.

3.2 NATIONAL/COUNTRY OBJECTIVES

The basis for the Union to act in the area of research and technological development is confined to the encouragement of these activities through demonstration projects and the promotion of cooperation, largely through the multiannual framework programme - the most relevant of which for the evaluation period was FP6 (2002-2006) with a budget of EUR 17.5 bn. This represented around 4% of EU spending on R&D during the period. The main policy levers in the area of research, development and innovation remain at individual state level, and are closely linked to education, fiscal and industrial policies (even defence to a certain extent). The Lisbon process did not introduce any new competencies at EU level, relying instead on an 'open method of coordination' whereby innovation performance is continuously monitored and reported. Whilst all EU member states subscribe to the Lisbon process, country performance varies widely across the EU.

European Trends in R&D

The issues facing Europe are clearly illustrated by the trends in R&D spending across OECD countries as a proportion of GDP[13]. The best performing EU countries (Finland and Sweden) are ahead of the international competition, whereas Europe as a whole still lagged significantly behind in 2004. Nor is the problem simply one of cohesion, as some of the most advanced economies in Europe are also lagging behind the USA and Japan in terms of R&D spending. According to the OECD:

"Lower R&D intensity in Europe relative to the United States and Japan is partly linked to cyclical conditions, but is primarily due to structural factors. These include the make-up of Europe's business sector, in particular the small size of its information technology manufacturing and services sectors, as well as a business climate which, in several EU countries, does not yet adequately encourage private investment in research and innovation."

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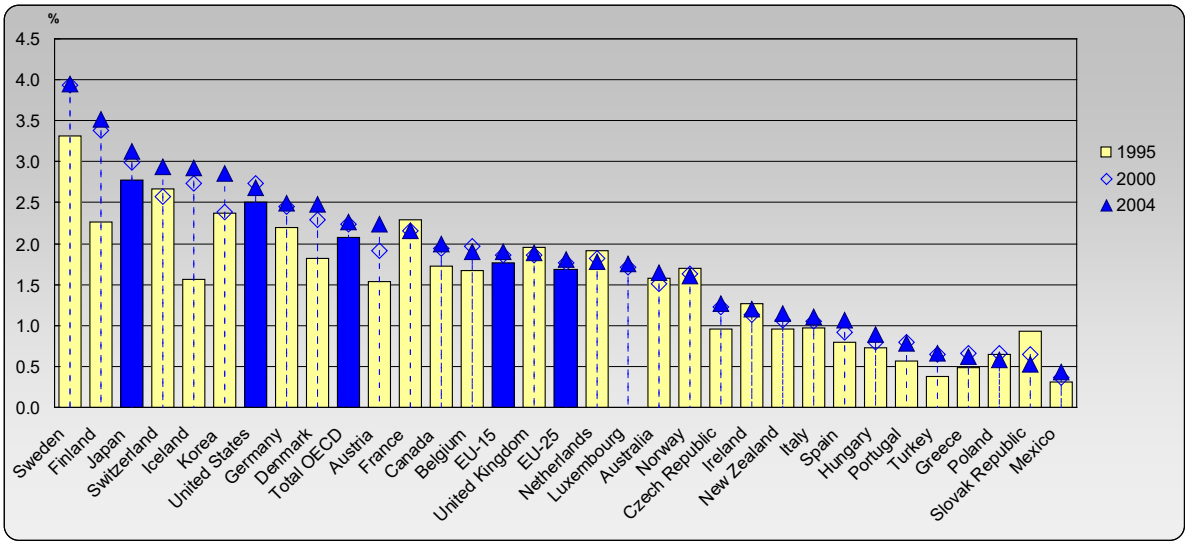
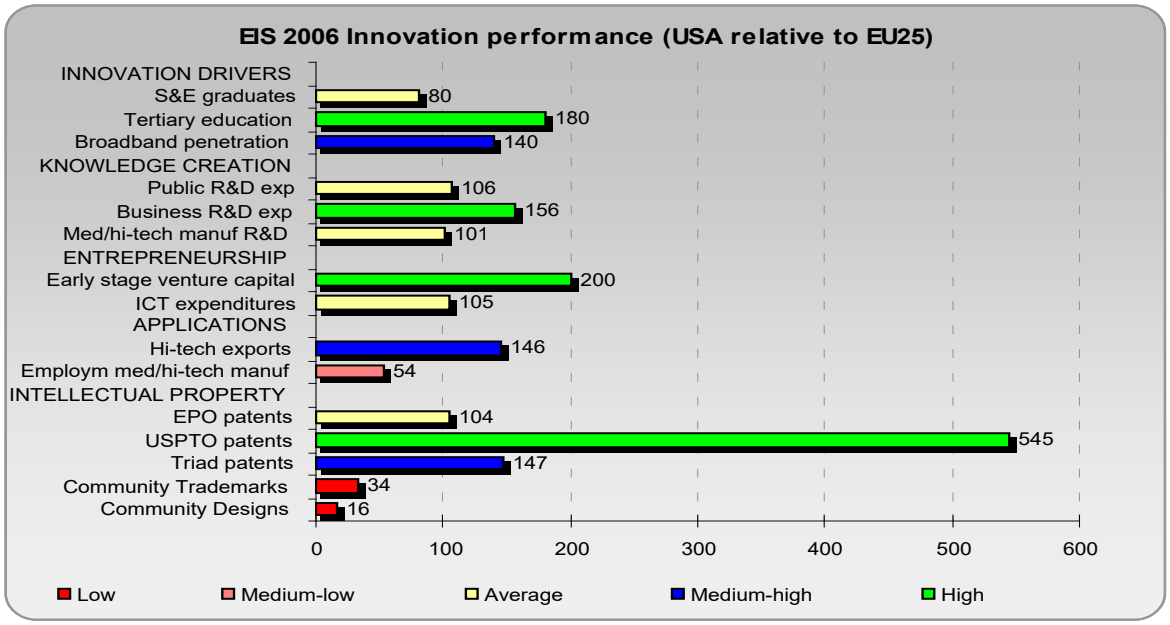
12 Green Paper on Innovation, COM (95) 688 FINAL/Towards a European Research Area, COM (2000) 6 FINAL/The International Dimension of the European Research Area, COM (2001) 346 FINAL/The Regional Dimension of the European research Area, COM (2001) 549 FINAL/More Research for Europe: Towards 3% of GDP, COM (2002) 499 FINAL/The European Research Area: Providing New Momentum, COM (2002) 565 FINAL/Choosing to Grow: Knowledge, Innovation and Jobs in a Cohesive Society, COM (2003) 5 FINAL/Investing in Research: An Action Plan for Europe, COM (2003) 226 FINAL/Putting knowledge into practice: A broad-based innovation strategy for the EU, COM (2006) 502 FINAL

13 OECD Science, technology and Industry Outlook, OECD, 2006



Whilst the differences are quite clear, the underlying reasons have been subject to much debate and study. As part of the Lisbon process, a number of innovation indicators were established and monitored[14]. The following chart shows the main differences in key indicators for EU25 relative to the USA[15].



The EU is still lagging in most key indicators, including both public and private R&D spending. In 2004 the European Council set up a High Level Group, chaired by former Dutch Prime Minister Wim Kok, which concluded that *"The EU and its member states have clearly themselves contributed to slow progress by failing to act on much of the Lisbon Strategy with sufficient urgency"* and suggested urgent action in five key policy areas:

- **the knowledge society**: increasing Europe's attractiveness for researchers and scientists, making R&D a top priority and promoting the use of information and communication technologies (ICTs);
- **the internal market**: completion of the internal market for the free movement of goods and capital, and urgent action to create a single market for services;

14 European TrendChart on Innovation, www.trenchart.org

15 >100 denotes USA better than EU25, <100 denotes EU25 better than USA

- **the business climate**: reducing the total administrative burden; improving the quality of legislation; facilitating the rapid start-up of new enterprises; and creating an environment more supportive to businesses;
- **the labour market**: rapid delivery on the recommendations of the European Employment Taskforce; developing strategies for lifelong leaning and active ageing; and underpinning partnerships for growth and employment;
- **environmental sustainability**: spreading eco-innovations and building leadership in eco-industry; pursuing policies which lead to long-term and sustained improvements in productivity through eco-efficiency.

These areas of deficiency are still broadly reflected in most recent innovation indicators, suggesting a stubborn resistance to treatment, but whilst action is still required across a broad range of policy, it is clear that research and development still remains a top priority for EU policy making. The widely varying country performance reflected in OECD surveys, together with the uneven distribution in the EIB lending portfolio discussed in §2, suggest that any action should have a strong country-specific element. From the outset the Lisbon process has stressed the importance of social cohesion (see §3.1.1) and since RDI tends to concentrate in more developed economies this might imply, for example, increased activity in education and ICT for those countries with less developed RDI. This would allow a better distribution of i2i activity amongst countries.

3.3 EIB POLICIES AND MANDATES

3.3.1 The Innovation 2000 Initiative

Some of the background to EIB involvement in lending for research, development and innovation is given in §2. The area as such had been eligible before but had not been a priority before the launch of the Lisbon process in March 2000. The EIB was actively involved in preparations for the Lisbon summit, and presented a position paper to the ECOFIN Council meeting in February 2000. The Bank offered to contribute "Towards a Europe based on innovation and knowledge" by intervening in five key areas: Human Capital, SMEs and Entrepreneurship, Research and Development, Networks, and Diffusion of Innovation

A special framework for action was proposed, to be called the "Innovation 2000 Initiative" (i2i), that would utilise existing instruments - although it was acknowledged that new instruments might need to be created. The Bank's Board of Directors approved the framework and implementation guidelines for the i2i policy in May 2000, with an initial EUR 12 to 15bn lending envelope over 3 years. It was recognised at the outset that *"the Bank will have to increase its range of instruments, modify its definition of investment and appropriately adapt its working mechanisms. New financial instruments, complementing the Bank's traditional long term loans, may need to be defined, to better suit the reduced amortisation periods for certain investment or the lack of physical collateral."*

The lending programme under i2i was to bring about a shift of focus in the type of projects financed, towards such projects which, through their nature and characteristics, appeared to be particularly prone to support innovation and the capacity to innovate the Union. Crucially therefore, i2i was to involve a reorientation, within existing eligibility rules, towards projects contributing to innovation. The main areas of operation were defined as:

- Human Capital
- SMEs and Entrepreneurship
- Research and development
- Information and communication technology networks

The i2i policy has been identified as a "Top Operational Priority" in the EIB Corporate Operational Plan (COP) since the mid-year update in July 2000. In 2001, i2i was extended to the Accession Countries (following the Stockholm Summit of March 2001).

3.3.2 The Innovation 2010 Initiative

As the end of the original lending envelope approached, the Bank began to prepare for its extension and review, and in March 2003 the "Innovation 2010 Initiative" was launched. Although broadly an extension of the previous initiative, the Innovation 2010 Initiative proposed a number of refinements in the light of operational experience:

- The proposed core areas of operation were reduced from four to three:
  - Education & training
  - Research & development and (extended by) innovative downstream investment (products and processes), notably in the private sector[16]
  - Creation and dissemination of ICT (hardware, and content and applications)
- Geographical coverage was enlarged to include the western Balkans
- The complimentarity of EIB and EIF operations was to be further developed and more systematically underlined, notably when defining operations relating to innovative SMEs
- It was proposed to refer to i2i as a 'common interest' eligibility under Art. 267 c) of the Treaty whilst at the same time abandoning reference to 'international competitiveness'.

Under the heading of "research & development and innovative downstream investment (products and processes), notably in the private sector" (RDI), special emphasis was to be put on the following areas:

- Coordination and cofinancing of key initiatives supported by the 6th EU Framework programme for Research and Technological Development (FP6)
- Support for cutting edge R&D activities by European companies
- Support to private initiatives implementing and combining research results
- Reinforcement of national programmes aimed at boosting innovation, notably by SMEs
- Development of appropriate financial products to support medium sized companies engaged in R&D activities
- Finance for incubator-type structures catering for the needs of young and technologically orientated companies
- Support to public research facilities, including basic research (like CERN)

Although it was not envisaged that the new i2i framework would involve a different risk profile from that registered with operations to date, the adaptation of existing instruments and further use of the Bank's Structured Finance Facility (SFF) were anticipated.

3.3.3 Subsequent Development

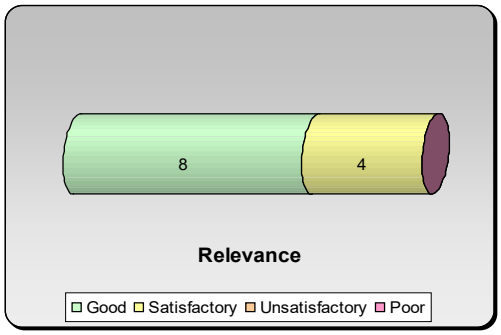
By the time the bank's eligibility criteria were formally altered in March 2004, these priority areas had evolved further in response to numerous Commission policy initiatives, including the European Action for Growth initiative, launched at the Brussels Council of December 2003, and its associated Quick Start programme:

- Developing Community research networks, platforms, organizations and programmes (support for financing of FP6 projects and initiatives within thematic areas)
- Facilitating European human resources in science and technology (Development of poles, knowledge networks of centres of excellence in R&D)
- Strengthening regional and local endowment for R&D and Innovation (science and technology parks, incubator centres and technopoles)
- Furthering private sector investments in R&D and innovation (private sector R&D and innovation with emphasis on SMEs. R&D co-operation between European industrial firms. - Research Platforms)

The Spring 2005 Council called on the EIB to extend its Structured Finance Facility to R&D projects and to explore with the Commission new ways of using Community funds as levers for EIB loans. This initiated a series of bilateral discussion resulting in the launch of the Risk Sharing Finance Facility (RSFF) as part of the 7th Framework Programme (2007-2013). RSFF is an innovative new financing instrument aimed at expanding the ability of EIB to provide financing to innovative projects that have a higher risk profile than the Bank's main lending portfolio.

[16] subsequently commonly referred to as RDI – the subject of this evaluation

3.4 PROJECT RELEVANCE



All projects evaluated in depth are considered to contribute to "the continuous process of transforming increases in human knowledge into innovation, and subsequently into total factor productivity and competitiveness gains", and therefore to contribute to the general Lisbon process. Some projects contribute only partially, but many of the projects examined also address other priority lending areas at the same time, especially regional development, human capital and environment. Given the rapidly changing policy framework within this period, this can be considered as a significant achievement.

3.4.1 RDI Relevance

In looking at the extent to which individual projects contributed towards achieving the policy objectives to which they were relevant, the assessment focused on those policy objectives relating to RDI, although consideration was also given to other policy priorities where these were relevant. Many of the projects examined also addressed other priority lending areas at the same time, especially regional development (projects 3-7 and 10-12), environment (projects 2, 5 and 9) and human capital (education) (projects 8 and 11).

Policy in this area is wide ranging and has evolved significantly over time. Rather than attempt to map this progression to individual projects, the evaluation considers a single overarching objective for the EIB RDI policy; does the project contribute to *"the continuous process of transforming increases in human knowledge into innovation, and subsequently into total factor productivity and competitiveness gains."*[17]

In considering how much a project contributes to this objective, the following indicators were considered:

- The proportion of the project investment related to RDI
- Whether the project was likely to contribute to an increase in R&D spending
- The support mechanism employed (whether the project directly contributed to the creation of knowledge or whether it provided indirect support, through for example the provision of infrastructure.)

All projects evaluated considered to contribute to "the continuous process of transforming increases in human knowledge into innovation, and subsequently into total factor productivity and competitiveness gains", but the extent to which projects contributed to this objective varied.

For some of the projects examined, the RDI component was considered to represent less than 100% of the project. Although EV notes that practice in the attribution of a proportion of a project to a given eligibility has now changed, this was not the case during the evaluation period, and suggests that the value of the RDI portfolio was overstated during the period[18]. However, in general those projects with only a partial contribution to RDI contributed strongly to other lending priorities and as a result the overall relevance of the sample was rated satisfactory or better.

3.4.2 RDI Scale

The projects examined in detail were located at different points on the RDI scale (see §1). Three projects (dealing with the discovery and production of new molecular entities) were considered to span the entire innovation scale (stages 3, 6 and 8). Five projects were considered to be located in the Innovation part of the cycle (stages 7 to 9). Of the remainder, two were public university research programmes (stage 2) and the remaining two projects were judged to be at the Development part of the cycle (stages 4 to 6).

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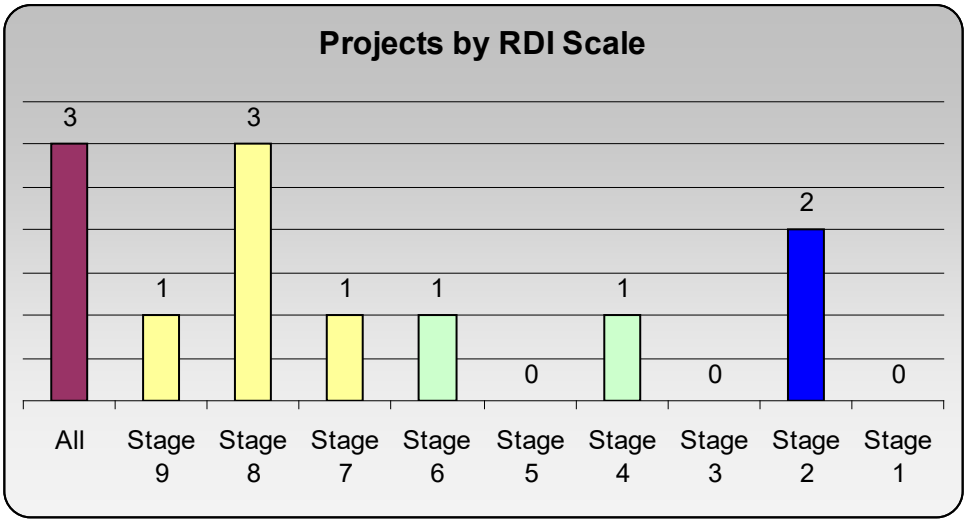
17 This phrase was incorporated in the launch of the Bank's Innovation 2010 Initiative in June 2003.

18 In the case of project 5, for example, the proportion of R&D identified in the project cost at appraisal was less than 10%.

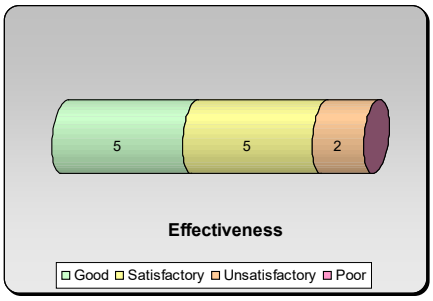


Although the classification according to RDI scale is necessarily approximate, when plotted on the above chart, it appears that the Bank's intervention in the private sector, perhaps due to the nature of the companies' field of activity, was more orientated towards projects which are at the 'Innovation' end of the scale and in only two cases (projects 4 and 10) were the beneficiary of the project SMEs. By contrast, there also appears to be a significant under representation of activities in the middle of the scale. Whilst SME activity is not confined to any particular part of the scale, it is possible that the two issues are related. Although not directly comparable, these findings were broadly confirmed as part of the extended analysis in §4.6 (PCRs).

4. PROJECT PERFORMANCE

Project performance, relating to EIB's second pillar of value added, is assessed using three core evaluation criteria, namely Effectiveness, Efficiency and Sustainability, which are all rated individually. The Environmental performance of the project is reflected in these core evaluation criteria, but is also extracted and rated separately for emphasis.

4.1 EFFECTIVENESS



Project Effectiveness rates the extent to which the objectives of the project have been achieved, or are expected to be achieved, taking into account their relative importance, while recognising any change introduced in the project since loan approval. The evaluation looked at the following parameters: a) implementation: coherence with the technical description, timing, costs and procurement, b) operation: management and organisation of project operations, environmental performance, cooperation and coordination with counterparts.

The rating for the effectiveness criterion is good for five projects and satisfactory for a further five. Of the two projects rated unsatisfactory, project 5 did not achieve its implementation objectives and only a part of the project contributed indirectly to RDI. Project 3 was the first commercial operation of a new industrial process and went significantly over budget, resulting in financial difficulties for the operator.

4.1.1 Project Objectives

In looking at the extent to which individual projects achieved their objectives, the rating assessment concentrated on the physical and operational objectives of the project, but with due consideration of the inherent characteristics of each project. Four projects involved activity at more than one stage of the RDI scale. Eight projects involved activity at the Innovation end of the scale, and the two projects involving research were public programmes.

The majority of project promoters were private industrial companies, although two involved public administrations. The project types could be classified into two main groups, support for capital

intensive industrial innovation (5), support for industrial R&D programmes (4) and support for the public research sector (2). The remaining project involved a science park. In general, the competence of the promoters to implement the projects has been high.

Physical implementation: This was more relevant for six projects involving physical infrastructure. The remaining six projects were programmes over a pre-determined period.

Physical projects were generally completed on time and within budget, with the exception of project 4 where costs were similar but the scope was considerably reduced, and project 10, where significant cost overruns were incurred overcoming implementation problems resulting from the innovative nature of the process. Procurement was not generally an issue as none of the projects fell within the scope of EU directives on public procurement.

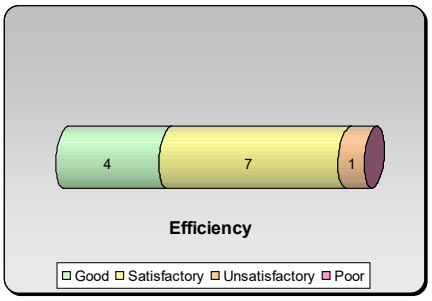
Case Study (Project 4) – Science Park

The provision of attractive facilities and specialised services play an important part in encouraging the formation and growth of technology companies. The project promoter had developed a highly successful business model on this basis that also dovetailed with comprehensive government policies establishing Centres of Expertise based around regional clusters. The project involved the next phases of expansion of the promoter's facilities in three locations catering for a wide variety of technology companies, including start-ups and incubators. The success of the model rests on the specialised services provided onsite but also on the design of the buildings themselves, which encourage interaction and communication amongst small companies working in similar sectors.

Operational Performance: The fast moving nature of technological innovation also tended to be reflected in management structures. Five of the projects underwent changes of management as a result of changing company structures. One further public sector project was also subject to substantial political change during the implementation period. However, all of the operations visited during the evaluation were technically sound, functional and in good condition and the management considered appropriate.

Due to the specific character of research projects, their direct long-term employment effects are in most cases relatively limited. However, they do represent high value jobs, both for the EU and for the local economy and the projects have contributed to creating and/or stabilising employment for hundreds of skilled people (project 1 alone involved some 900 researchers over the full implementation period of 3 years).

4.2 EFFICIENCY



Efficiency considers whether the project objectives are achieved in a manner that represents the efficient use of resources. Efficiency is also one of the main considerations when choosing between projects to allocate scarce resources. Generally the EIB uses two main measures: the FIRR and ERR (see Glossary), and these are still used here for projects which lend themselves to this approach. However, for this evaluation a different approach has been developed to reflect the more intangible nature of some of the investments[19]. All but one project have a positive rating for the Efficiency criteria (91%). This is considered to be a particularly good result given the wide scope of the subject, its constantly evolving policy framework and, given the wide range of RDI projects, the lack of a unified approach to project definition and selection. Only one project is rated Unsatisfactory, and this was a public research programme whose quality was considered to lag behind other European countries.

The Bank's ex ante project selection and evaluation process varied considerably depending on the nature of the project, and there was a certain lack of consistency in approach and in choosing key variables. In general, projects which were 'near market' were assessed using conventional methodology. In some other cases a comprehensive assessment of the promoter's capability and development pipeline was made, and in others no project selection rationale was offered.

[19] This cannot therefore be directly compared with the ex-ante assessment made at the time of project appraisal.

4.2.1 Efficiency Indicators

Most investment in research, development and innovation is intended to ultimately produce a tangible outcome (the exception being fundamental research, which is curiosity driven). However, the eventual pay-off in terms of economic activity may be many years away, and may not materialise at all. Research projects can fail at any stage right up to the brink of commercialisation, but the risk of failure is not constant over the innovation cycle; reducing as the activity comes closer to the market. Futhermore, although a research and development project may fail to produce a tangible result, it will always produce an increase in the overall stock of knowledge – intangible capital.

RDI projects are therefore concerned not only with physical assets but also with an increase in the stock of knowledge. This gives rise to a number of challenges in defining and evaluating intangible investments. The valuation of intangible assets is not new, and there is an extensive literature on the subject. However, the literature is largely aimed at helping business entities to track the intellectual capital of their organisation based on complex analyses of current and historical data and is therefore of limited assistance to the EIB in the ex ante selection or ex post evaluation of individual RDI projects.

RDI Efficiency Indicators

The intangible nature of some RDI investments, together with the uncertainty of their outcome, pose particular challenges for the ex ante appraisal, implementation monitoring and ex post evaluation of RDI projects. However, they share certain common characteristics, depending on their position in the innovation cycle, which should allow a consistent approach to project selection and evaluation.

Research projects – These are by definition far removed from any commercial application, and the eventual outcome in terms of economic benefit cannot therefore be readily evaluated. They have therefore been evaluated on the basis of the extent to which they advance the frontiers of knowledge. This is in turn directly linked to the quality of research institutions undertaking the research and the **quality of research output**, as determined by peer review and international comparison.

Case Study (Project 3) – Manufacturing Research Programme

The project was one of several examined which involved direct support for the research and development programme of a successful medium sized European company. The three year programme involved the new product pipeline for the company as well as the development of product and process improvements. The proportion of its earnings that a company devotes to its future products is a key variable for its success, and tends to vary by industry. Highly competitive and rapidly changing industries need to invest heavily in the future. This type of operation poses a new set of challenges for the EIB in that the project is largely 'intangible' and subject to extensive change, depending on the active management of the programme by the promoter. In this case the promoter had a successful track record and a strong pipeline management procedure in place.

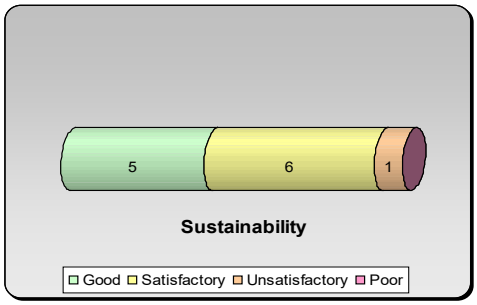
Development projects – At this stage, the management of a company's product pipeline is a key to future success. For private sector promoters, the ability to efficiently manage their **development pipeline** has a direct impact on financial results, and so this and the company's **recent financial performance** were taken as efficiency indicators in these cases. In some cases, sufficient information was available to make a conventional rate of return assessment. High failure rates can be expected at this stage in the innovation cycle. In order that the knowledge gained is spread amongst the widest possible range of actors, the extent to which **knowledge spillover** is enabled (collaborative effort, especially those involving the public sector, but also industry initiatives) was also considered as a contributory factor.

Innovation projects – Being closer to commercial application, these projects have been assessed in the conventional way by examining the project's **financial and economic rate of return**.

Most projects exhibited a mixture of elements, and the indicator chosen was therefore decided on a case by case basis, with a preference being given to a quantitative analysis where possible. The following table shows the indicators adopted for each project, together with the efficiency rating awarded. The differing approaches mean that boundaries between ratings cannot be quantified.

No.	Sector	RDI Scale	Principal Efficiency Indicator	Rating
1	Manufacturing – IT	7	Company financial performance	Good
2	Manufacturing – Biotech	3/6/8	Company financial performance	Good
3	Manufacturing – Paper	8	Development pipeline	Good
4	R&D Infrastructure	4/5	FIRR	Sat
5	Electricity/Gas/Water	8	Company financial performance	Sat
6	Manufacturing – Pharmaceuticals	3/6/8	Development pipeline	Sat
7	Manufacturing – IT	9	FIRR	Good
8	R&D	2	Research quality	Sat
9	Manufacturing – Miscellaneous	3/6/8	Company financial performance	Sat
10	Manufacturing – Iron and Steel	6	FIRR	Sat
11	Education	2	Research quality	Unsat
12	Manufacturing - IT	8	Company financial performance	Sat

4.3 SUSTAINABILITY



The sustainability criterion looks at the probability that the resources will be sufficient to maintain the outcome achieved over the economic life-time of the projects, and that any risks can be managed.

For this evaluation, the risks associated with sustainability have been grouped according to the type of project. For conventional tangible investments, the physical, operational and financial sustainability is examined. For project comprising largely intangible investments, the likelihood that the knowledge generated will eventually contribute to productive economic activity is assessed based on the track record and prospects of the promoter. For public research programmes, the likelihood that adequate funding will continue to be available is assessed based on the country innovation track record.

4.3.1 Tangible Investments

In all of the cases examined, the promoters' technical and managerial/ operational capacity to adequately maintain the projects' assets was not in doubt and the distinguishing risk factors were largely generic industry related.

Projects 1, 8 and 12 are in the same highly competitive industry, which has a history of volatility, but the companies involved have demonstrated the ability to ride out previous industry downturns. There is a risk of production re location to lower cost countries, but Projects 1 and 8 are located in well established regional clusters which are considered to mitigate this risk and are rated satisfactory, whereas project 12 is considered to be more vulnerable and is the only project rated unsatisfactory.

Case Study (Project 6) – Pharmaceutical company

The project involved support for the product development pipeline of a medium sized European pharmaceutical company. This included the search for new molecular entities, their formulation and testing according to strict regulation, and the development of manufacturing processes for the production of new medicines. The programme also researched the development of new applications and delivery methods for existing products. The requirement for extensive clinical trials to test the efficacy and side effects of new medicines requires heavy investment in the product pipeline and substantial risk of failure, even after formal product launch. In this case the promoter had a successful product portfolio and a strong product pipeline, introducing several new medicines over the project period. This strong performance led to the take over by a larger company during the project period.

Project 5 involves a large utility company with a strong market position which would normally have warranted a rating of good. However, it is likely to be exposed to competitive pressure in the future, and so the rating was downgraded to satisfactory. Project 10 launched a new industrial process and experienced financial difficulties during implementation. However, it is now in full production and has been bought out by its biggest customer. In addition, demand for the new process

is likely to grow in the future based on tougher environmental regulation. It has therefore been given a rating of good. Project 4 involves the building and leasing of office and laboratory space. The company has shown strong growth and sound management, and does not build speculatively. It is one of the most successful companies in its sector and has been given a rating of good.

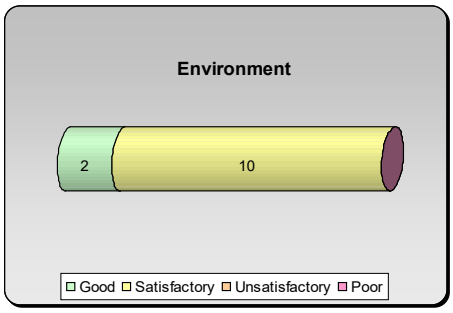
4.3.2 Intangible Investments

Four projects involved the research programmes of medium sized companies. Project 2 involves a long established bio-tech company with a strong market position and an excellent track record in managing its product pipeline and converting research into economic activity. However, it was rated satisfactory rather than good since it acknowledges some longer term reputational risks. Project 3 has a similar profile but did not exhibit these risks and was therefore rated good. Project 9 was the research programme for one of Europe's largest and longest established companies. It has the management and resources to emerge from its current financial problems, and so was rated satisfactory. Project 6 concerns the research programme of a medium sized company with a strong track record in bringing forward new products. It has now been taken over by a larger rival, and this is seen as strengthening its prospects further and it has been given a rating of good.

4.3.3 Public Research Programmes

Two projects represented support for public tertiary education research systems. Project 8 is located in a country with a strong economy and good track record of innovation and has therefore been given rating of good. Project 11 is located in a new member state that has previously neglected its science system. However, the government subscribes to the Lisbon process and has recently brought in policies to strengthen the system. The project has therefore been rated as satisfactory.

4.4 ENVIRONMENT



Environmental and social impact assesses the project from an ecological point of view. This criterion examines the immediate impact of project implementation and operation, but also extends to the wider view of the project and its long term consequences on carbon emissions, energy efficiency, green spaces, involvement of local communities, transport, local employment, social cohesion, etc. where these are relevant.

Consideration of environmental factors is already included within the internationally agreed criteria of relevance, effectiveness, efficiency and sustainability, together with the overall assessment of project performance included above. They are repeated here separately firstly to emphasise the importance the EIB attaches to environmental and social matters, and to clearly distinguish environmental factors from those other considerations taken into account when rating relevance, effectiveness, efficiency and sustainability.

The RDI projects examined varied considerably in scope. Those projects where the RDI component was associated with large physical infrastructure required an Environmental Impact Assessment according to EU regulations (Directive 97/11/EC). Of these, most were considered under Annex II as urban development projects, although project 6 involved the erection of new power lines and was classified under Annex I. For those projects involving the construction of new infrastructure, most were the extension of existing industrial sites or science parks, and were not subject to a formal EIA process. The residual impacts predicted during the Bank's assessment process were generally confirmed ex post and were of a minor nature.

In the course of the approval process, all projects are subject to an environmental review, in which compliance with local, state and federal law is verified and all relevant permits were obtained. It was also ascertained that all practices used by the companies regarding the disposal of waste and hazardous materials complied with national legislation and international standards. No project evaluated ex-post raised concerns from this point of view. All promoters were aware of their obligations under the new REACH regulations adopted in December 2006.

None of the projects examined had specific environmental objectives, but in the majority of cases, the RDI component of a project was aimed at improvements to products and processes that would eventually lead to the improvement of the environment through reduced power consumption both in production processes and products (projects 1, 3, 5, 7, 9 and 12), improved safety (projects 1 and 9), the curing of disease (project 6), the replacement of hazardous chemicals and search for alternative fuels (project 2), or the treatment of waste (project 10).

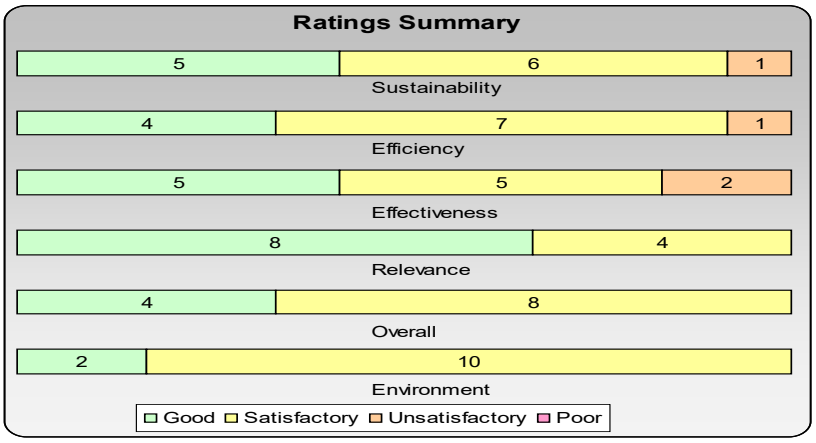
Case Study (Project 10) – New Process for Treating Industrial Waste

The project was located in an industry that had traditionally disposed of waste to land fill but which was becoming increasingly regulated. Existing processes were available, but these only partially treated the waste. The promoter invented a new process for treating industry waste which produced 100% marketable by-products. Following a successful pilot plant (also supported by EIB) the process was scaled up to a first industrial application. This involved the solution of substantial additional technical problems, and the project ran into difficulties at one stage. However, these were successfully solved (partly through the buy out of the company by its largest customer) and the process is now operational and finding additional markets. The project is an example of one where new technology is producing environmental improvement.

For those projects involving the support for research programmes, promoters were found to be highly responsible in their approach to regulatory compliance and ethical issues. All private sector promoters involved in research operated certified environmental management systems. However, the support of projects at the frontiers of science pose a particular issue for the Bank in terms of environmental and social assessment which, in these cases, goes beyond the question of strict regulatory compliance. Projects 2 and 6 both involve research in life sciences, which are – as far as they are related to the use of genetically modified organisms – regarded as controversial areas, and the companies themselves acknowledge these reputational risks in published literature.

4.5 OVERALL PROJECT RATINGS

Ratings on relevance and project performance: *As outlined in the introduction, the operations were evaluated on the basis of internationally accepted evaluation criteria of Relevance, Efficacy, Efficiency and Sustainability (see graph below). These individual ratings are considered together to produce an overall rating for the project. This is not an arithmetical exercise, and reflects the extent to which individual aspects contribute to the whole on a case by case basis. Environment is rated separately, but is already accounted for within the four main ratings.*



The overall ratings confirm that the Bank is financing projects that are performing well. Relative deficiencies linked to cost overruns and delays, partial non-achievement of initial objectives are counterbalanced by other positive aspects of the projects.

4.6 EXTENDED ANALYSIS

In order to extend the scope of the analysis EV have examined the self evaluation (Project Completion Report) information completed during the evaluation period, together with a selection of other projects which have been examined on a desk review basis so as to examine specific aspects of RDI projects which might be of relevance to the evaluation.

Extended Scope : Survey of Self-Evaluation Procedure through Project Completion Reports (PCRs) for Research, Development and Innovation (RDI) Projects

25 PCRs were issued by PJ in the new format for RDI projects between 2004 and 2006. The total signed value of the corresponding 25 projects is EUR 3.9 bn or 17% of total RDI signatures. The 25 Projects are distributed over 12 countries : 24 projects have a single-country base and one project is based in two countries. The sector distribution of the PCRs is headed by "Manufacturing" at 56% (14), and followed by "Real Estate" (R&D) at 16% (4), "Human Capital" at 12% (3), "Electricity & Gas " 8% (2) and, finally, there are 2 multi-sector projects. While no PCR template was left blank, two PCRs contained only sparse information.

RATINGS
Value Added Pillar 1

Country	New-Format PCRs	VALUE ADDED PILLAR 1				Total
		High	Medium	Not Acceptable	Not Stated	
Austria	4	4	0	0	0	4
Denmark	2	2	0	0	0	2
Finland	1	0	1	0	0	1
France/Netherlands	1	1	0	0	0	1
Germany	9	6	1	1	1	9
Greece	1	1	0	0	0	1
Italy	1	0	1	0	0	1
Luxembourg	1	1	0	0	0	1
Poland	3	3	0	0	0	3
Portugal	1	1	0	0	0	1
Sweden	1	1	0	0	0	1
TOTALS	25	**20**	**3**	**1**	**1**	**25**

The contribution to EU Objectives was rated "High" in 80% (20) of PCRs reviewed, "Medium" in 12% (3), "Not acceptable" in 4% (1) and no comment was given for 4% (1). The borrower for the project rated "Not acceptable" declared bankruptcy in 2004.

Value Added Pillar 2

Country	New-Format PCRs	VALUE ADDED PILLAR 2				Total
		Good	Satisfactory	Un-satisfactory	Not Applicable	
Austria	4	4	0	0	0	4
Denmark	2	1	1	0	0	2
Finland	1	0	1	0	0	1
France/Netherlands	1	1	0	0	0	1
Germany	9	6	1	1	1	9
Greece	1	0	1	0	0	1
Italy	1	1	0	0	0	1
Luxembourg	1	1	0	0	0	1
Poland	3	3	0	0	0	3
Portugal	1	1	0	0	0	1
Sweden	1	1	0	0	0	1
TOTALS	25	**19**	**4**	**1**	**1**	**25**

The Quality and Soundness of the project was rated "Good" in 76% (19) of the PCRs reviewed, "Satisfactory" in 16% (4), "Unsatisfactory" in 4% (1), and described as "Not Applicable" in 4% (1).

Value Added Pillar 3

The section on the financial benefits obtained by the use of EIB funds is not completed. During the course of this evaluation, the Bank has undertaken steps towards clear procedures regarding the VA Pillar 3 self-evaluation process.

RDI Scale

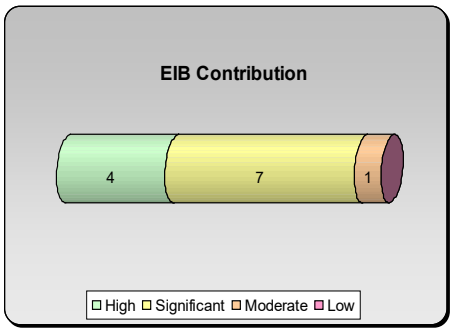
The PCRs for those projects not included in the in depth evaluation were examined for position on the RDI Scale (see §1). Projects contributing to more than one stage were counted more than once.

RDI Scale	Research			Development			Innovation		
	1	2	3	4	5	6	7	8	9
Projects	1	2	1	1	2	7	2	2	9

KEY FINDINGS

- The contribution to EU Objectives was "High" in 80% of projects, and the quality and soundness of the project was "Good" in 76% of cases reviewed. This is higher than found in previous evaluations and higher than the sample examine in depth.
- There is no assessment of the Bank's financial value added.

5. EIB CONTRIBUTION



RDI is a relatively new area of activity for the Bank and because of this there was an exploratory element to the Bank's involvement, seeking those sectors and promoters where it could add maximum value. The evaluation period (2000–2006) was also a transitional one in adapting existing client relationships and seeking new counterparts.

Ex post, the Bank's main strength in the projects evaluated resided in its role of providing large financial resources in tune with the needs of the promoter and at competitive rates and terms, although, there was also an important non-financial contribution for some projects.

Overall, four projects are rated High. These are generally where both financial and non-financial value contributions were important, or cases where the Bank provided a strong signalling effect. In the other cases, the projects benefited mainly from significantly better financial terms than the alternative funding available. One case is rated as moderate, since the promoter was a large company with ready access to alternative sources of funding.

5.1 FINANCIAL VALUE ADDED

The significant financial value added (FVA) of the Bank, as the leading EU long-term lender, lies according to all promoters in its terms, which are characterised by favourable interest rates, long loan maturities/grace periods and flexible disbursement. Funding advantages were reported to be high, although most were considered more modest. In some cases, the counterparts gave an official appreciation on the FVA of the EIB loan. However, in all cases promoters reported that the Bank's involvement was helpful but not critical.

Promoters also reported a number of other forms of financial value and in 8 out of 12 cases is currently negotiating a further loan with the EIB. For project 12 the promoter reported a strong signalling effect of the Bank's involvement smoothing the process of obtaining EU grants. Some promoters felt that the Bank's requirement for commercial guarantees was onerous and felt that the Bank should have been prepared to take more risk.

5.2 OTHER CONTRIBUTION

The projects in the sample were located in the EU and comprised support for successful companies in highly specialised sectors. The opportunity for the Bank to add value in technical terms were therefore limited. For RDI projects there are also particular confidentiality considerations in sharing information regarding new products and state of the art research, and several promoters were reluctant to release information. However, in all cases promoters cited the Bank's familiarity with the sector and his business as advantageous.

The EIB added a significant or high non-financial contribution to two projects. During the implementation of project 10 there were significant problems with the development of a new industrial process which eventually led to a financial restructuring. During this period the

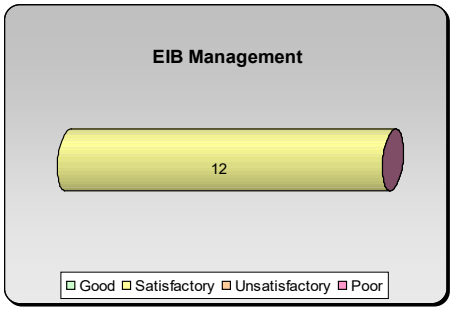
Case Study (Project 11) – Public sector research programme

Public sector research has a less immediate impact on economic activity but is none the less a crucial part of creating the knowledge economy, carrying out activities that are too far from market to be of interest to all but the largest companies, but which pump prime the entire innovation cycle. The project involved indirect support to the research component of the science and tertiary education system in a new member state. In this case EIB involvement played an important role in ensuring stable funding over a politically turbulent period and both by insisting on the creation of a project implementation unit and continuous contacts during the implementation period helped to ensure that funds to the science system were not reduced. Whilst the project contributed strongly to cohesion objectives, its value to RDI objectives was more debateable. The project provides a good example of the ability of the EIB to provide non financial added value within the EU.

Bank's technical knowledge of the sector was invaluable in assessing the changing risk situation and substantial staff time was invested in assisting in rescuing the project. The result was that a project with high environmental externalities is now a going concern.

The provision of formal technical assistance was not generally a feature for RDI projects, but in one case (see box) the TA component foresaw support to the borrower in the form of a project implementation unit to assist with the supervision and reporting of the programme, which in addition to its formal role, provided much needed stability to the project during a period of rapidly changing political priorities.

6. EIB PROJECT-CYCLE MANAGEMENT



EIB project cycle management has been perfected over a long period of time and is systematic, structured and well adapted to the vast majority of the Bank's operations. The projects examined were all managed in a satisfactory way, but there was some evidence that this was a result of ad hoc adaptation of established procedures and methods in response to RDI as a relatively new area of operation. Whilst the (successful) result is a credit to the professionalism of the staff involved, there is now a need for a more systematic review of the appropriateness of the Bank's established project-cycle management for RDI projects.

6.1 PROJECT IDENTIFICATION AND SELECTION

The Bank has good relationships with many of the main counterparts, who are often repeat borrowers. Most of the projects evaluated in-depth were identified responding to requests from existing customers or as a follow up from earlier projects. The process of seeking new counterparts and evolving new products is lengthy, and it is perhaps not surprising that most of the projects examined were with existing counterparts using established loan products. However, the net result may be that the EIB intervention is restricted to certain parts of the target market (see §3.4.2) and that these are not necessarily the parts where the Bank can add most value in terms of its policy agenda.

Once identified, the projects went through the initial internal screening process, which has contributed to the selection of sound projects in all cases.

6.2 APPRAISAL

RDI projects pose particular problems for the appraisal process, beginning with the definition of the project itself. In cases involving research programmes, the approach taken varied from a detailed description of the research projects planned (projects 1 and 3), to a simple reference to the timescale of the programme (projects 6 and 9).

Case Study (Project 9)– Research Programme for Large Industrial Company

The project represented three years of research for a larger industrial company in Europe. It posed some challenges for the management of the EIB project cycle that in the end were overcome to a satisfactory extent but raise some issues that need to be addressed on a more systematic basis. The company considered its research programme to be highly confidential and project details were supplied on a very selective basis. The company also sold off part of its activities during the implementation period, complicating the monitoring of the project.

Project appraisal was usually well-structured and systematic, reflecting the Bank's standard approach, although the approach varied considerably in detail. This was sometimes, but not always, related to the Bank's normal modulation procedures. This was particularly evident in the approach taken to the economic life of the project, which in some cases was related to the life of project infrastructure, in others to the product life cycle or the equipment life, and sometimes no assessment was offered. Predicted economic life reflected the wide range of different technological areas covered and varied from 5 years (project 9) to 20 years (project 11) but in general it was felt that

stated economic life would tend to be an under estimate if more consideration were to be given to the intangible elements of the projects.

For 'near market' projects the economic value of the project was calculated using conventional rate of return techniques but there was no common approach for projects containing significant intangible elements. In some cases (project 6 for example) a comprehensive assessment was made of the promoter's track record and research pipeline, and project management system. Others (projects 2 and 9) were modulated on the basis that the promoter was well known to the Bank, and no analysis was offered.

Where demand and cost forecasts were required, in particular for large industrial projects, these were handled well, showing considerable knowledge of the particular sector involved. It was noted that recurrent R&D costs were considered as eligible, but in two cases (projects 8 and 11) recurrent education (teaching) costs, in line with current eligibility criteria under i2i/RDI, were excluded.

The internal handling of environmental issues during the approval process was considered satisfactory in all cases. However, it was felt in two cases (projects 2 and 6) that the appraisal documentation should have placed more emphasis on the potentially controversial nature of the research areas involved in the project.

6.3 PROJECT IMPLIMENTATION/FINANCING ARRANGEMENTS

Most of the projects' promoters were satisfied with the EIB's internal handling and procedures to support a smooth project implementation, although some considered EIB loan procedures as heavy or lengthy. Two promoters particularly appreciated the Bank's management of the project and the personalised relationship on offer.

However, changes in project scope were sometimes either not recorded or not reflected in contract amendments. This is particularly important in the case of RDI projects since they will almost certainly vary in scope. In one case (project 9) the promoter pointed out that the Bank's standard loan contract was not well adapted to a project which was largely intangible.

In general all promoters appreciated the Bank's flexibility in matching disbursement to individual needs. In one case (project 7) nine separate loan tranches were signed.

6.4 MONITORING

Project follow-up and physical monitoring during project implementation has been limited. Only five out of the twelve projects requested some form of progress reporting, usually a relatively light requirement, and some of these were not received, nor followed up. Given the fast changing nature of the technology companies involved and that the research programmes are expected to change through active management, it might be expected that reporting requirement would be strengthened. In addition, in no case was any specific environmental monitoring specified although two projects involved research in potentially controversial areas.

Case Study (Project 2)– Research Programme for a Bio-Tech company

The project involved the research programme of a long standing and highly successful European bio-tech company producing organic molecules with industrial applications. These replace the use of potentially harmful chemical agents and increase the efficiency of industrial processes. The company's products therefore have significant positive environmental externalities, although the production process (but not the products themselves) involves the use of genetically modified organisms and the company itself acknowledges this as one of its principal reputational risk factors, despite strict compliance with existing legislation.

Completed Project Completion Reports (PCRs) were examined for the sample. Most of these self assessments coincided with the ex post situation, with only one project (project 10) considered to have been a little optimistic. None of the reports contained information on financial value added (Pillar 3).

6.5 OTHER ISSUES

Coordination and cooperation with other institutions (EU Commission, International Financial Institutions) and banks has not been a feature for the sample considered.

Significant organisational changes have been implemented in the EIB over recent years, such as a multi-directorate Centre of Expertise (CoE) on i2i and more recently (January 2006) on the lending side, the establishment of a new horizontal department within OPS-A 'Action for Growth Instruments (AGI)'. The Bank's technical directorate (PJ) has now been reorganised to reflect current lending priorities, including RDI. Although some projects have seen significant changes in operational staff, the shorter duration of RDI projects means that institutional memory is less of an issue in this area.

Appendix 1

EVALUATION PROCESS, CRITERIA AND METHODOLOGY

Background

In accordance with EV's Terms of Reference, the objectives of this evaluation are threefold:

- to assess the quality of the operations financed; this is achieved using generally accepted evaluation criteria - in particular those developed by the Evaluation Cooperation Group, which brings together the evaluation offices of the multilateral development banks. The criteria are: **Relevance, Effectiveness (efficacy), Efficiency** and **Sustainability** with particular emphasis on Environment.

- to assess the EIB contribution (both financial and non financial) and the EIB management of the project cycle.

Methodology for the assessment of RDI project Efficiency

RDI projects have one key distinguishing feature; they are principally concerned with an increase in the stock of knowledge. Unlike infrastructure investments, RDI projects therefore create intangible assets. This gives rise to a number of challenges in defining and evaluating intangible investments. The valuation of intangibles assets is not new, and there is an extensive literature on the subject. However, the literature is largely aimed at helping business entities to track the intellectual capital of their organisation based on complex analyses of current and historical data and is therefore of limited assistance to the EIB in the ex ante selection or ex post evaluation of individual RDI projects. Despite these problems of specification and measurement, the literature does confirm the important contribution made by intangibles to individual businesses and modern economies.

The intangible nature of RDI investments, together with the uncertainty of their outcome, pose particular challenges for the ex post assessment of project efficiency. There appears to be no simple transformation which would allow these to be treated in an equivalent manner to tangible infrastructure investments. However, RDI projects share certain common characteristics, depending on their position in the innovation cycle, which should allow a consistent approach to project selection based on a set of variables whose importance will vary with position within the innovation cycle.

Nature Variables	The inherent characteristics of the project and promoter which are known at the outset; sector of activity, budget and programme, extent of collaboration, track record, management and performance measurement systems.
Goal and Attainment variables	The aims and objectives set at the outset which represent the initial rational for undertaking the project.
Outcome and Output variables	The measures which will be used to assess the extent to which goals and objectives have been reached; new patents filed, products launched, papers cited etc.
Impact variables	The extent to which a project has had an impact on policy goals beyond its own immediate aims and objectives; employment, cohesion, environmental improvement, knowledge spillover etc.

It is therefore first necessary to categorise projects on the basis of their position within the innovation cycle. This is not a straightforward process, and a more detailed discussion of definitions is given in Appendix 2. For the purposes of this evaluation the following simplified classification has been adopted:

Research projects – These are by definition far removed from any commercial application, and the eventual outcome in terms of economic benefit cannot therefore be readily evaluated. Nature and Goal variables will tend to predominate. They should therefore be evaluated on the basis of the extent to which they advance the frontiers of knowledge. This is in turn directly linked to the quality of research institution undertaking the research and the quality of research output, as determined by peer review.

Development projects – Nature variables will also be important for these projects, but in addition such projects will tend to have specific goals, and so Outcome variables will also feature strongly. High

failure rates can be expected at this stage of development, and in order that the knowledge gained is spread amongst the widest possible range of actors, the extent to which knowledge spillover is enabled should feature strongly in the assessment of this type of project. Collaborative efforts should be targeted, particularly those involving the public sector, but also industry initiatives.

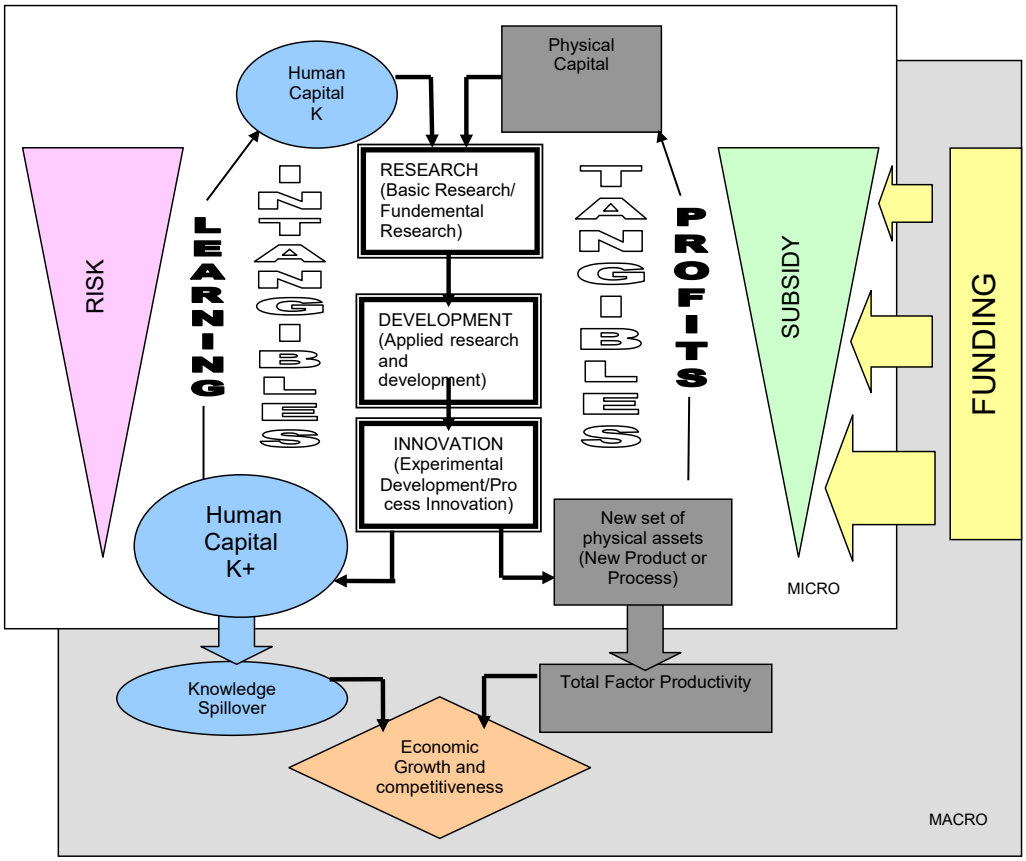
Innovation projects – Being closer to commercial application, these projects should be able to be assessed on the full range of variables, but with Output and Impact variables predominating. Projects should be selected on the basis of the extent to which they are genuinely innovative with preference being given to those giving rise to new economic activity rather than replacing existing activity.

In order to find a common vocabulary to describe projects which cover a wide range of sectors these three categories have been further sub divided based on the series of practical steps necessary to generate new ideas and transform them into economic activity. The following table summarises the resulting RDI Scale, which has been used to classify the projects by position within the innovation cycle, and the corresponding indicators considered when assessing the efficiency of these projects.

RDI Scale		Efficiency (Quality) Indicators
Stage	**Description**	
1	Intellectually-driven pure/fundamental research in disciplines with broad scientific relevance and no foreseeable economic application. Small number of world class institutions.	**Research:** Quality and track record of research organisation (publication/peer review). National/international ranking of research departments. Success in attracting grant funding.
2	Intellectually-driven research within established disciplines/technologies. Field leading investigation at the technology frontier.	
3	Applied research designed to further/deepen knowledge within existing technology boundary with practical applications in mind. Possibly some early commercial interest/involvement.	
4	Technology 'start-up' applying results of leading edge research with a view to developing practical applications. Public sector supported (direct or indirect) but with commercial objective. Small high-risk organisations or large organisations with ample resources.	**Development:** Extent of spillover network. Distance from technology frontier. Market/economic potential. Risk of non-progression.
5	Collaborative development (including public-private partnerships) within existing industries to produce new or next generation technology which is either too far from market or too expensive to be funded by individual players.	
6	Technical development of products or processes within existing industries following a defined longer-term technology 'roadmap'. Scaling up and prototype development. Large investment requirements but largely self funding. Some public sector support in form of grants/incentives. Possible collaboration between competitors.	
7	Development of 'new generation' products involving substantial modification/innovation of available technology. Defined 'time to market'. Largely self funded by medium to large industrials. Some overlap with main commercial competitors.	**Innovation:** Defined business plan linked to commercial success of similar products. Expected rate of return or payback period.
8	Process/product innovation designed to modify/improve/differentiate existing products. Substantial duplication amongst competitors. Self funded.	
9	Process innovation designed to reduce cost or extend life of existing product range already in commercial production.	
10	Investment in maintenance and operation of existing commercial production. Expansion of existing production.	Not considered as RDI.

These definitions are not intended to be exclusive, or definitive, but are used in this evaluation to provide a common vocabulary to describe a wide variety of activities across many sectors.

RDI AND THE INNOVATION CYCLE



The process of discovering or creating new knowledge, of developing it into new economic activities, which then in turn spin off new knowledge and new ideas that start the process all over again, is generally referred to as the Innovation Cycle. The Innovation Cycle has three main constituent parts; research, development and innovation. When analysing the innovation cycle it is essential to remember that any linear description of the process, though useful for theoretical purposes and to establish a terminology, is a simplification and that in the real world there is no "one-size-fits-all" scheme to describe the innovation cycle. One possible representation is shown above.

The existing body of knowledge detained by an organization is continuously recombined by different actors. This can happen in an informal way (such as learning-by-doing) or through a formalised research and development process. This process, if successful, results in a technological innovation that embodies significant knowledge advancement and brings forward the technological frontier. The innovation cycle takes place in both the private and public sector.

Although the importance of the innovation cycle is commonly acknowledged, its working mechanisms are less well understood and the definitions and terminology employed can be confusing. The EIB has developed a policy agenda entitled the Innovation 2010 Initiative (i2i) which incorporates Education & Training as one of the three lending priorities. Education and training are not normally considered to be part of the Innovation Cycle as such, but are clearly central to the development of a knowledge economy. The second lending priority under i2i is Research & Development and Innovative Downstream Investment, commonly referred to as RDI. This could be construed as encompassing the entire Innovation Cycle by itself, but the Bank has chosen to separate out a particular activity sector, Information and Communication Technology (ICT) as the third lending priority of the i2i policy.

RDI COMPONENTS

Knowledge has been defined as a "fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information". Knowledge normally resides in individuals and can be tacit or explicit: firms operating in a knowledge-based economy are aware of the importance of preserving and enhancing the body of knowledge they own. Knowledge management has therefore become common within organizations operating in research intensive and competitive environments and has eventually extended to manufacturing and most traditional sectors.

In terms of knowledge, the innovation cycle can be roughly summarised as an iterative process where the existing body of knowledge and other assets that represent the actual RDI resource endowment of an organisation are utilized in a flow of activities generating innovations, technological advances and further knowledge that is added to the stock of the organisation's assets. However, going beyond this very general description in describing and categorising the innovation cycle is difficult, one of the principle difficulties when dealing with RDI projects is to find common definitions of the terminology which has developed for a variety of purposes, including the policy arena and common public usage.

In June 1963, the OECD met with national experts on research and development (R&D) statistics in Frascati, Italy. The result was the first official version of the "Proposed Standard Practice for Surveys of Research and Development", better known as the Frascati Manual[20]. Today's R&D statistics are the result of the systematic development of surveys based on the Frascati Manual and are now part of the statistical system of the OECD member countries. The Manual describes R&D as follows: "*Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications"*.

In addition to providing a common basis for gathering statistics, drawing the boundary between R&D and Education on the one hand and R&D and Industrial activity on the other, these definitions have become increasingly important over the years, firstly as part of the EU State Aid framework and subsequently as part of the Lisbon Process. The need to establish accounting rules for the former, and monitoring procedures for the latter has driven the development of the Manual, now in its sixth edition. However, even now the border between experimental development and normal industrial activity is not always clear in practice. The Frascati manual proposes a rule of thumb for distinguishing the two concepts. If the primary objective of the activity is to make further technical improvement to a product or process then the work comes within the definition of R&D. If on the other hand, the aim is to develop markets, to do pre-production planning or getting a system work smoothly then the work is no longer R&D. However, depending on the nature of the activity it might be considered as a special category of industrial activity referred to as "Innovation". The concept of Innovation is discussed further below.

Research

The process of seeking or creating new knowledge for its own sake, which is driven solely by intellectual curiosity, is variously described as Research, Pure Research, Basic Research, Fundamental Research or Blue Sky Research.

> The Frascatic Manual describes basic research as aimed at discovering or creating new knowledge and the understanding of a natural phenomenon or conceptual problem. It is curiosity driven with no particular practical application in mind. Although it does not tackle a concrete technical problem, basic research makes a relevant contribution to the technological advance of an economy in areas such as mathematics or pure physics. Basic research is generally perceived as "scientific", carried out in special facilities such laboratories, universities and technological parks.

Due to the high degree of uncertainty that characterises the potential outcome at this stage, basic research is often performed by public bodies or subsidised by public entities. Since basic research is

[20] OECD, Frascati Manual Proposed Standard Practice for Surveys on Research and Experimental Development, 2002

not oriented towards the resolution of a practical problem the course of a project may change dramatically as research goes on.

The economic benefits from basic research are difficult to quantify, but are clearly present. Martin and Salter[21] (1996) have provided an interesting list of economic benefits deriving from basic research:

- New, useful information
- New instrumentation and methodologies
- Skills, especially skilled graduates
- Access to networks of experts and information
- Solving complex technological problems
- Spin-off companies

Basic research is funded mainly by governments that try (and often succeed) in directing it towards national priorities. Scientists themselves are usually opposed to the idea that research priorities should be established by the changing perceptions of national priorities, but in volume terms basic research has been mostly targeted at engineering and other defence related activities. Cutbacks in basic research can impede the development of new basic concepts and hinder the progress of science, thus reducing the rate at which new valuable applications are found at a later stage.

Universities provide a very good environment (though not the only one) for performing basic research and pursuing payoffs that are distant in time. Because of this, the outcome of basic research and the quality of the tertiary education system that provides the bulk of researchers to universities are interlinked. This is a field where the gap between Europe and other advanced economies needs to be bridged.

An important issue which often occupies policy makers is how much should a society invest in basic research. When an organisation invests in R&D it expects to get future benefits from it. When society allocates money to those activities it also loses the opportunity to allocate those resources to other activities – this is the social cost of a given expenditure in basic research. However, the marginal value of the good of "basic research" to society often exceeds the marginal value of the private organisation that invests in it. In this case the allocation of resources to basic research that maximizes private profits will not be optimal for the society that has therefore an interest in supporting collectively the production of this good. A degree a market failure therefore exists for basic research, which is therefore largely supported by government in a variety of ways. Governments decide how much of their budget should be allocated to the university system and promote incentive schemes to reduce the costs for companies that undertake basic research by direct grants or tax incentives.

Development

The process of developing new ideas and applying new knowledge in a manner directed towards finding a productive economic application, however distant, is variously referred to as Development, Experimental Development, Technical Development, Industrial Research, Applied Research or Technological Development.

The Frascati Manual defines Applied Research as *"also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective."*

Development work is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives. It involves considering the available knowledge and its extension in order to solve particular problems. In the business enterprise sector, the distinction between basic and applied research is often marked by the creation of a new project to explore promising results of a basic research programme. The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. Applied research gives operational form to ideas. The knowledge or information derived from it is often patented but may be kept secret.

Innovation

[21] B Martin, A Salter, D Hicks - 1996 *The Relationship Between Publicly Funded Basic Research and Economic Performance*. - University of Sussex, Science Policy Research Unit

The process of applying existing knowledge in new ways as a means to develop new or improved economic activity is referred to as Innovation or Experimental Development.

> The Frascati Manual defines experimental development as systematic work, drawing on knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

This is a very wide definition, and could be said to encompass almost all economic activity in the private sector. However, the concept of Innovation is further broadened by another OECD document produced as part of the 'Frascati Family' known as the Oslo Manual[22]. This manual has been developed as the basis for various innovation surveys, notably the European Community Innovation Survey (CIS). In the Oslo Manual, Innovation is defined as "the implementation of a new (for the enterprise, for the industry, for the world) solution aiming at enhancing its competitive position, its performance, or its know-how". Innovation is also defined as "… the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services". Innovations can be either technological or non-technological. Non-technological innovations such as organizational or managerial innovations that involve the creation or alteration of business structures, practices and models are not included in accountancy definitions of R&D. Technological innovations can be product/service innovations or process innovations.

- **Process innovation** entails the implementation of a new or significantly improved production or delivery method. A wider definition of process innovation can also include supply chain innovations.
- **Product innovation** entails the introduction of a good or service that is new or substantially improved. This might include improvements in functional characteristics, technical abilities, ease of use, or any other dimension.

Implicit in the Oslo manual is the admission that the Frascati concept of R&D, wide though it is, does not capture all of the aspects of knowledge generation and entrepreneurial behaviour which are strongly linked to economic growth.

Problems of Definition

Breaking the Innovation Cycle down into its constituent parts gives rise to many conceptual and operational problems, even at a fairly aggregate level. They seem to imply a sequence and a separation which rarely exist in reality and when applied at a practical level become even more involved. The three components of RDI may sometimes be carried out in the same centre by essentially the same staff. Moreover, there may be movement in both directions. When an RDI project is at the applied research/experimental development stage, for example, some funds may have to be spent on additional experimental or theoretical work in order to acquire more knowledge of the underlying foundations of relevant phenomena before further progress can be made. Moreover, some research projects may genuinely straddle categories. Almost any research activity carried out within a private company could be said to have a specific practical aim or objective. By the same token, it also would be difficult to argue that the development of the CERN particle accelerator, clearly publicly funded basic research, had no practical aim or objective.

Further difficulties are added when trying to develop practical policy definitions. As discussed above the Bank's Innovation 2010 policy includes education and training at one end of the scale and process innovation at the other end of the scale, neither of which are considered R&D by the Frascati Manual. On the other hand the Bank's concept of RDI does not include the ICT sector. In addition the Bank has to factor in the practical lending aspects of the organisations involved in its loan contracts, as well as the need to record its activities using NACE codes[23] which also do not correspond easily.

[22] OECD, Oslo Manual: The measurement of Scientific and technological activities, 2003

[23] See Glossary

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