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SPRINT/EIMS Policy Workshops: Public Policies to Support Tacit Knowledge Transfer

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Tacit Knowledge Transfer

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Foreword

The design, implementation and evaluation of policies promoting innovation and technology transfer have undergone a series of changes. In the 1970s policy was to a large extent an ad-hoc and judgmental process. However, during the 1980s policy changes have been more informed and professional in outlook.

In order to continue this development, SPRINT/EIMS has launched a series of state-of-the-art reviews in the field of innovation and technology transfer support. These so called "policy workshops" are mainly directed to public sector scheme managers and the aim is to discuss recent developments in innovation policy, to exchange experience of best practice, to assess existing as well as future Community action in these fields and to discuss options for concerted actions.

One of SPRINT objectives is to help improve the effectiveness of national and regional innovation policies and to tune Community and Member State actions. As such these workshops provide important inputs as well as providing an opportunity to exchange information among scheme managers in the Member States.

It is now well known that competence is often accumulated in people and is therefore tacit and intangible in form. Despite its importance, the subject has been neglected in the analysis of corporate strategy and public policy. In order to contribute to an increased awareness, the second SPRINT/EIMS workshop, titled *Policies to support tacit knowledge transfer,* focused on public sector schemes supporting tacit knowledge transfer by stimulating mobility from university to industry and from industry to university as well as public schemes promoting site demonstration, user supplier relationships and technology promoting clubs.

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SPRINT/EIMS POLICY WORKSHOPS

Public Policies to Support Tacit Knowledge Transfer

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REPORT OF THE PRESENTATIONS AND DEBATES IN THE POLICY WORKSHOP ACQUISITION AND DIFFUSION OF TACIT KNOWLEDGE

Luxembourg, 25-26 May 1993

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WELCOME AND INTRODUCTION

The topic of the second 1993 SPRINT/EIMS policy forum workshop, the transfer of tacit knowledge, is a new and difficult subject. The issue is also difficult to tackle in public policy. The task for this workshop, the assessment and evaluation of public measures to support tacit knowledge, was thus a complex one. Up to now the central focus of public action concentrated on formal codified knowledge. Today there is a growing awareness that not only formal knowledge, but also informal knowledge is at the centre of the innovation process. New and creative methods will have to be developed to support dissemination of tacit knowledge in the future.

This workshop was also a learning experience for experts in the new field. The presentations of the different schemes formed a reflection of the progress. There is the paradoxical situation that governments want to stimulate the informal interaction of people with new regulatory mechanisms, which by definition are formal. Hence the key question in the two days was how to stimulate the intangible.

SESSION I PERSPECTIVES ON TACIT KNOWLEDGE

Because the concept of tacit knowledge is still very blurred, the presentations in this session were meant to clarify the issue and give some classifications and typologies. By doing so the workshop hoped to achieve a more uniform definition of the concept.

The first presentation introduced several viewpoints to discuss the concept 'tacit knowledge'. The speaker argued that if one takes a broad view of tacit knowledge, aspects of it can be codified. Only pure tacit knowledge does not have the potential to be codified. Technology is partially tacit, intangible and embedded in equipments and products, individual knowledge/know-how and organisational routines. We can distinguish different types and levels of competences: cognitive and behavioral competences at the individual level, collective or organisational competences and finally network competence. Comparing Japan and the Western industrialised countries regarding their approach to tacit knowledge, we can distinguish a tendency in the West to make the tacit explicit, to codify it. That what is held by the individual should be appropriated by the group. In Japan on the contrary, it is said that knowledge is kept at the individual level, competence is thus better preserved as implicit rather than as explicit, thus there is a process of internalisation. A key concept is learning mechanisms, tacit knowledge being partially about how to learn. We could adopt a development theory on cumulative learning mechanisms. The core of tacit knowledge is built in the incremental

improvement stage where there is a search for a dominant technology. Subsequently it is destroyed in later stages when the knowledge becomes more and more codified. Tacit knowledge also has a reverse side, since it is difficult to undo and therefore it can lead to inertia.

A second contribution to the debate addressed the issue from a macro point of view. The speaker stressed it would be very difficult to categorise the non-codified knowledge because it is different from sector to sector, from firm to firm, however there are some common features. Accumulated technological wealth is a mixture of tacit and codified knowledge, but these assets are more than the sum of each individual in the collective. Important is the capability to assimilate and adapt external - tacit - knowledge. Firms relying too much on the tacit knowledge of in house engineers can be hampered in their ability to absorb external knowledge.

Tacit knowledge is very fragile, it can disappear with the people that carry the knowledge. Therefore in the Western world there has been a continuous drive to codify this knowledge. Another reason to codify the tacit is that the carrier of this knowledge wants the benefit of exclusive property right, to keep the competitive edge. Therefore the tacit is codified into patents for instance, to monopolise it for a certain period.

To benefit from tacit knowledge we should make efforts to disseminate it. One way to achieve this is through human mobility. According to one speaker, in his country (France) this does not work very well, it is not part of national culture. Another form of appropriating tacit knowledge is to buy out other companies with the relevant knowledge. Networks are important instruments of disseminating knowledge (this is a topic in the next SPRINT workshop), as are alliances between firms to create mixed teams. In these teams firms and particular SMEs can absorb external knowledge. It is difficult to assess what the contribution of tacit knowledge is to our competitive edge. In any case we are a learning economy and if we want to benefit from tacit knowledge we should train people in how to integrate best tacit knowledge.

In the discussion that followed the presentations it was mentioned that the notion of improving the absorbtion capacity, especially in mixed teams within SMEs is an interesting concept. From the policy point of view it can serve as an important justification for many mobility and networking schemes. The challenge for policy makers is to think of ways to encourage these networks while at the same time keeping them open to external knowledge and disseminate their own knowledge.

SESSION II Policy perspectives

The third presentation addressed the policy issues raised by tacit knowledge. As a result of the change in the way firms organise innovation, our understanding of innovation in aggregate models also changes. This understanding has shifted from the linear model where innovation was understood as a series of sequential steps with isolated stages of activity, to a systems model of technical change which focuses on the interactive links between different stages and the composition of these linkages. In this model technical change is dependent on knowledge and the assimilation of information through learning. Tacit knowledge is an important element of this process. The interaction activities within firms, where tacit knowledge has to be transferred, creates major communication problems.

The change of approach also has its implications for public policies. There is a need for policies to support the capacity of organisations and firms to innovate and change through continual learning. Thus improving their absorptive capacity. This includes providing an infrastructure for networking and communication, learning and unlearning. Managing tacit knowledge means dealing with very specific cases, highly dependent of the sector, firms or individuals involved. The question is how to design policies that take these differences into account? One of the answers is that the policy debate should be viewed very much as a general framework in which a set of existing policies can be integrated and made far more acceptable. Isolated initiatives are not efficient, if not accompanied by a coherent set of supportive measures. Can we learn from the policy experiences in the countries and regions of Europe, given the uniqueness of the experiences? The speaker argued that in case there should be a role for the Community in this field, having a policy framework in which this role is embedded is vital. Once we have a framework, we can learn from the local and regional experiences without aiming at a convergence of policies which narrows the windows of opportunity.

In the debate following the presentations, a British expert stressed that there should also be a role for the Community and the national governments in the diffusion of tacit knowledge. In his view governments should provide a return to firms that are prepared to diffuse their tacit knowledge and thus their core competence.

For a dynamic firm the interface with external knowledge and their capacity to absorb this is very important. A traditional company on the other hand will stick to their internal tacit knowledge. Policies should enable small companies to recruit external personnel and internalise some of the external knowledge.

This might accelerate the innovation process.

In the last presentation of the morning session an overview of the policy instruments was briefly presented It was based on the survey prepared for this workshop. In this survey the definition of tacit knowledge relied very much on the German concept of 'Erfahrungswissen' or knowledge through experience. According to the survey overview, there were very few policy instruments which directly and explicitly addressed the definition. To classify the material the researchers looked at it from an organisational perspective: what is transferred from whom to whom? In essence there are two dominant types of instruments which attempt to transfer "Erfahrungswissen". The first type is those that are transferring knowledge between higher education / research establishments and the target firm. This is by far the most common policy instrument. The second type of instruments addressed the inter-firm flows of tacit knowledge either through the collaboration of firms (co-makership, buyer supplier links etcetera) or between firms of the same industry. The survey did not identify many examples of policies supporting the flows between competing industries. Those cases that were found were usually instruments for firms that had been under strong competition pressures and restructures in the past, for example in the textile industry.

Most of the policy instrument operate within the boundaries of the national state or the region. Hardly any instruments aim at links across the borders, for instance firms with institutes abroad and, with the exception of the Irish scheme, no multinational companies are involved. To have a better account of the instruments, we refer to the overview in the following section of this report.

SESSION III Support of Tacit Knowledge Transfer by Stimulating Mobility

The chairman of this session stressed that the transfer of tacit knowledge is not a new phenomenon, it is only recently that we specifically label it as tacit knowledge. It is also not a new phenomenon in innovation policy, there are many examples of existing policies that include an element of tacit knowledge transfer. Thus there is not one way of supporting the transfer of tacit knowledge but a whole range of possibilities. The aim of the presentation of the schemes is to learn from each other how this particular form of transfer takes place.

The first presentation explained the operation of the Teaching Company Scheme (TCS) in the UK, one of the oldest schemes on mobility in Europe.

The objective of the scheme is a two way knowledge transfer between Higher Education Institutes (HEIs) and industry, by placing young graduates in the firm to work on a development project. At the same time it has the aim of training graduate students towards more professional knowledge. Related to the TCS is the Senior Academics in Industry Scheme, which temporarily - four to six months - places experienced researchers into the firm. This scheme is in its pilot phase and an evaluation is thus not yet possible.

In France there are two mobility schemes for the placement of technicians and researchers in France, CORTECHS and CIFRE. In both schemes a triangular partnership is created between the firm, a technician or researcher and a research centre. Public support consists of a contribution in the salary of the researcher or technician. Within the CORTECHS scheme (Convention de Recherche pour les Techniciens Supérieur) technicians are placed mainly in SMEs. The implementation and funding takes place at the regional level. In the CIFRE scheme (Convention Industrielle de Formation par la Recherche) researchers are placed in large and small firms with the educational aim to complete a doctoral thesis. This programme has a long history, between 1981 and 1991 more than 3800 agreements between companies and research centres were made.

In the discussion on these schemes it was argued that both the UK and the French schemes have the difficult task to bring together the different worlds of university and industry. The worlds differ in mentality, motivation and language. The approaches in both countries do not differ in essence, only in details. In Spain however, despite similar initiatives, the amount of tacit knowledge in the relatively small Spanish R&D infrastructure and industries, is limited in comparison to other EC countries.

The issue was raised concerning the motivation of firms to become involved in these type of schemes. The manager of the CIFRE programme, stated that training for research was the main objective behind setting up the scheme. One of the selection criteria for a placement is the motivation of the researcher to work in a particular industry. Thus firms are assured to attract someone who is motivated to work for them. From the experience of evaluations of CIFRE, an expert stated there is not one single strategy to participate. Some firms are pragmatic and use the programme to hire an expert at low cost. Others see it as strategic partnership with research centres. When the scheme was set up there was much opportunism with the participating firms. Today after several years of operation, firms have changed their attitude and become less pragmatic. They clearly see the strategic advantages of participating. The success of the scheme lies in improving the

mobility of the two worlds of research and industry which has always been a weak link in the innovation chain. A British expert argued that none of the firms motives are 'impure', saving money by hiring a cheap engineer is within the firm's logic. He confirmed the observation that the motivation of firms are at first short term oriented. However when their involvement lasts, the motivations shift to long term issues, the building up of partnerships.

There was a comment that for firms to integrate researchers who can transform tacit knowledge into explicit knowledge, is a way to increase their accumulated technological competence. The French schemes improve the firms capacity for absorption of innovation, by integrating them into a research network.

SESSION IV SUPPORT OF TACIT KNOWLEDGE TRANSFER BY SITE DEMONSTRATIONS

The first presentation in this session was on the Dutch "Demonstration Projects". They are part of the Programmatic Business Oriented Technology Stimulation (PBTS) action in the Netherlands. Within this integrated scheme, all stages of innovation are supported from research to implementation. In four technology areas, information, materials, environment and bio-technology, firms can apply for funding for a demonstration project. Here producers of new technologies can demonstrate them to a broad group of potential appliers or users. The objective is to improve the transfer and implementation of new technologies, since this stage of the innovation was seen as problematic. Another initiative is the organisation of 'round table' meetings between similar companies discussing their technological competence. The effects are mainly informal relations formed within a few years after the actual round table meeting.

The second scheme in the session was the Technology Oriented Information and Visit Programme (TOP) in Germany. This scheme supports site visits to leading companies with strong technological capability. The aim is to show other firms, mainly innovative SMEs, the state-of-the-art technology and at the same time enhance collaboration between them. A second, new objective of the scheme is to demonstrate managers from east Germany (where research is even more separated from industry) different forms of best practice. TOP is implemented by a publisher, because publicity and recruitment of host companies is the most important aspect of the success of the scheme.

During the discussion the question about the advantages of firms to open their doors to other companies was asked. Protection of company information

is a very sensitive issue for the firms involved and opening the doors could be contrary to the best interest of the hosting firm. This again raises the question of motivation to participate. In the German scheme the visitors are not direct competitors, the very aim is to bring together a cross-section of firms. Protection of information has to be secured by the companies themselves, they show only what they want to. The motives to participate as a host are the prestige for the corporate image of being in the catalogue, and finding new suppliers or customers.

In the case of the Dutch scheme the labelling effect of having a project awarded is an important motivation for firms to apply to the scheme. The financial funding is quite small. The motivation to join Round Table meetings is that firms, even if they are competitors can challenge each other to perform better.

DINNER SESSION

During dinner Mr. Tatsuno (Neo Concepts, USA) gave a presentation on the shifts in the focus of technology transfer in Japan. In the past technology transfer was dealt with in a very structured manner and on the organisational level. Today there is a move towards organising technology transfer in a more unstructured manner, at the group or individual level. Informal gatherings in Japan are as important as those in the formal work environment. The message for policy makers is to enlarge their programmes to involve groups and individuals, not only organisations. Mr. Tatsuno presented important managerial and business practices in Japan like job rotation to create generalists, establishing close contact with customers preferably in an informal social environment, and the cyclical pattern of new products through the functional divisions of the companies.
In Mr Tatsuno's view the most important element to understand the success of Japan is the close integration of R&D and engineering. This is in contrast with the US where both are separate activities often in different locations. In Japan managers gradually bring in manufacturing people into the R&D projects and gradually R&D people are phased out. This is technology transfer through people instead of through piles of paper. At the moment the dominant paradigms are shifting in Japan. The recession is also hitting Japan and mass manufacturing is moving to other Asian countries like China. Only the top segment of the market, new products with very a short development cycle will still be produced in Japan. At the moment the Japanese firms are vulnerable: corporate down sizing has begun, there is loss of market share in foreign markets and quality standards are not as relatively high as before.

Their solution to this is increasing horizontal integration for instance in global localised R&D networks. Mr. Tatsuno expects it will take 5 - 7 years for Japan to bounce back.

26 May

SESSION V: ISSUES OF STRATEGIC ORIENTATION, DESIGN, MANAGEMENT AND EVALUATION OF SUPPORT SCHEMES: PROBLEMS AND PERSPECTIVES

The morning session of the second day of the workshop started with a presentation on the role of Research Clubs, an initiative of the Science and Engineering Research Council (SERC) in the UK. Several of these clubs are supported by SERC. In the research clubs pre-competitive research is jointly sponsored by the SERC and the companies involved in the research project. Another type of research club are interdisciplinary research centres, concerned with industrial research. The speaker argued that tacit knowledge is concentrated in the later stages of innovation. In that stage the ideas start to become more competitive, thus firms are less likely to take initiative to disseminate this type of knowledge. Encouragement is therefore necessary, but it can not be enforced. Building up trust is the key word in the schemes.

In the following debate experts from other countries stated that they had similar schemes, for instance the CIRN clubs in France organised by CNRS and university - industry link schemes in Greece. The question was raised if this could be described as tacit knowledge transfer or staff training? This touches one of the central problems of the workshop: defining what tacit knowledge is. So far we have seen two different sets of tacit knowledge transfer. The first concerns a broad reservoir of industrial competence that cannot be codified or formalised. The other set is tacit knowledge transfer through communication between people, thus facilitating the human dimension. This underlines the complexity of the concept of tacit knowledge an its possible application to policy issues.

During the workshop we have also seen different motivations to design these schemes: to increase the industrial relevance of academic research, to improve the involvement of companies in basic research programmes, to support funding of public research, and to facilitate the exploitation of public research. Often there is a combination of goal in the schemes discussed during the workshop.

The second contribution in this session discussed how to stimulate transfer of know-how in user-supplier relationships. The Irish examples presented were the National Linkage Programme and the Techstart Programme, managed by Eolas. Within the first programme efforts are made to create strong trade links between indigenous Irish firms and foreign multinational companies based in Ireland. The intention is to optimise the quality standards of these SMEs and improve their strategic market position. Eolas assesses the demands of multinationals, selects suitable SMEs, establishes and maintains the partnerships. In the Techstart programme SMEs receive an employment subsidy to obtain external expertise by hiring technical graduates. Tacit knowledge is not an explicit aim in the programmes. However the problem of knowledge transfer plays an important role since person to person communication is still the best way to transfer technology.

The third issue raised in this session was on the evaluation of tacit knowledge programmes, illustrated by the French CORTECHS and CIFRE schemes The evaluations of these programmes were positive in the sense that the objectives of linking university with industrial research and offering industrial training to researchers and students, were met. Particularly SMEs have improved their technological competence from their involvement with the programmes. But some questions remained. One point is the different objectives of the partners. A problem that has not been solved is that SMEs which invest in the R&D schemes, usually ask for direct applicable industrial research. When the system began the majority of students came from the top universities, performing high quality - fundamental - research. This leaves the question what contribution the laboratories can make to these firms? An evaluation of the CIFRE scheme confirmed that at the start of the scheme there was a sharp compartmentalisation between industry and research. This has been reduced over the years, it was a slow process of learning.

SESSION VI COMMUNITY ACTIONS AND SUPPORT SCHEMES

This session provided three presentations of Community actions related to tacit knowledge transfer. The two first schemes, COMETT (CEC, Task Force for Human Resources, Education, Training and Youth, Brussels) and the Human Capital and Mobility Programme (CEC, DGXII, Brussels), are both mobility programmes.

COMETT (Community programme for Education and Training in Technology) supports exchanges of people between industry and university, training courses in advanced technologies and development of training

material. Starting from the assumptions are that there will be no harmonisation of national educational policies, COMETT intends to lower the barriers between different educational systems. The scheme is under evaluation and one point of discussion is a simplification of the structure of similar CEC programmes, since there are too many of them.

The Human Capital and Mobility programme promotes the transnational mobility of young researchers from all scientific and technological areas. The supported activities are fellowships, cooperation networks, large-scale facilities and Euroconferences.

One of the comments was that the scheme is highly appreciated, especially to overcome the arrears in the less favoured countries. A reduction of the bureaucracy involved for participants of the programmes was however strongly recommended.

The SPRINT programme (CEC, DG XIII), deals with tacit knowledge in several ways. In the four major action lines of the SPRINT programme, tacit knowledge is a crucial element of the technology transfer process, where the personal dimension is important. There is however no clear borderline between the tacit and non-tacit, it is more a continuum. Part of the SPRINT activities aim to formalise the tacit, as for instance in demonstration projects which show what the process of technology transfer implied. Emphasis is on the non-technological aspects of innovation.

An important point for discussion was the views of the experts attending the workshop on future perspectives of this policy area.

An expert from the Commission, argued that it will be necessary to keep stressing the importance of an integrated innovation concept, in which the human and non-codified factors are essential. On the national level he considered the main task for policy makers to co-ordinate the initiatives on tacit knowledge schemes and exchange the experiences. Initiatives tend to be designed very much within the national boundaries, but exchange of know-how should diffuse best-practice in policy through different nations and regions. The practical experiences with network-building, evaluations methods and so on can be formalised and would facilitate exchange of best practices in policy.

From a regional perspective it was argued that in less favoured regions there is only a small number of local linkages with universities possible. The latter prefer to be involved in large prestigious projects than in links with the local business community. Furthermore these institutions aim at codifying the

knowledge obtained in their projects, something which is not always in interest of the firms working with universities. Therefore one should not have to high expectations from schemes to promote regional and local firm - university linkages. Another issue that effects regions is that moving plants from one location to another raises problems in achieving the same productivity and quality standards. This has to do with a difference in tacit knowledge in regions. If regions have difficulties in achieving the same standards they are in danger of the closing down of regional establishments.
A German expert argued that the national perspective is still important in spite of the increasing role of other levels, i.e. the Community and regions. The competition between the levels is healthy, but we should work in parallel. In Germany the national authorities have assigned many responsibilities to the regional level. The task for the national level is to give the framework for policies and build the models. The task is to decentralise in the implementation.

In the final discussion it was remarked that besides facilitating tacit knowledge transfer one should not disregard the mechanisms to protect knowledge, since competitiveness to a certain extend also meant the capability to appropriate this knowledge. This makes public intervention in this field enormously complex.

Although it was not possible to come to clear-cut conclusions or solve the definition problems during the workshop, one can nevertheless see some progress in this direction. Summarizing the general feeling the chairman argued that the workshop contributed to four different aims: Firstly it helped to focus on the role of tacit knowledge, defined as "Erfahrungswissen", in the innovation process, Secondly the participants worked towards a common language in this field. Thirdly by analyzing and discussing several interesting examples of schemes, policy makers were able to exchange views of best practice in several areas of tacit knowledge transfer. Last but not least the workshop also revealed that some areas of policy making such as the ones which were based on informal building of social networks, were much more difficult to capture and hence to formulate in policy instruments. It is particularly on the latter that one could expect future developments.

INTRODUCTORY PAPERS

"Tacit knowledge and technology transfer"

Jeremy Howells
The Judge Institute of Management Studies/
Centre for Business Research.
University of Cambridge, UK

"The role of policy in supporting the acquisition, diffusion and protection of tacit knowledge"

Anthony Arundel and Luc Soete
MERIT, Maastricht, The Netherlands

TACIT KNOWLEDGE AND TECHNOLOGY TRANSFER

Jeremy Howells

1994

The Judge Institute of Management Studies/
Centre for Business Research,
University of Cambridge

TACIT KNOWLEDGE AND TECHNOLOGY TRANSFER

1. Introduction and Definition

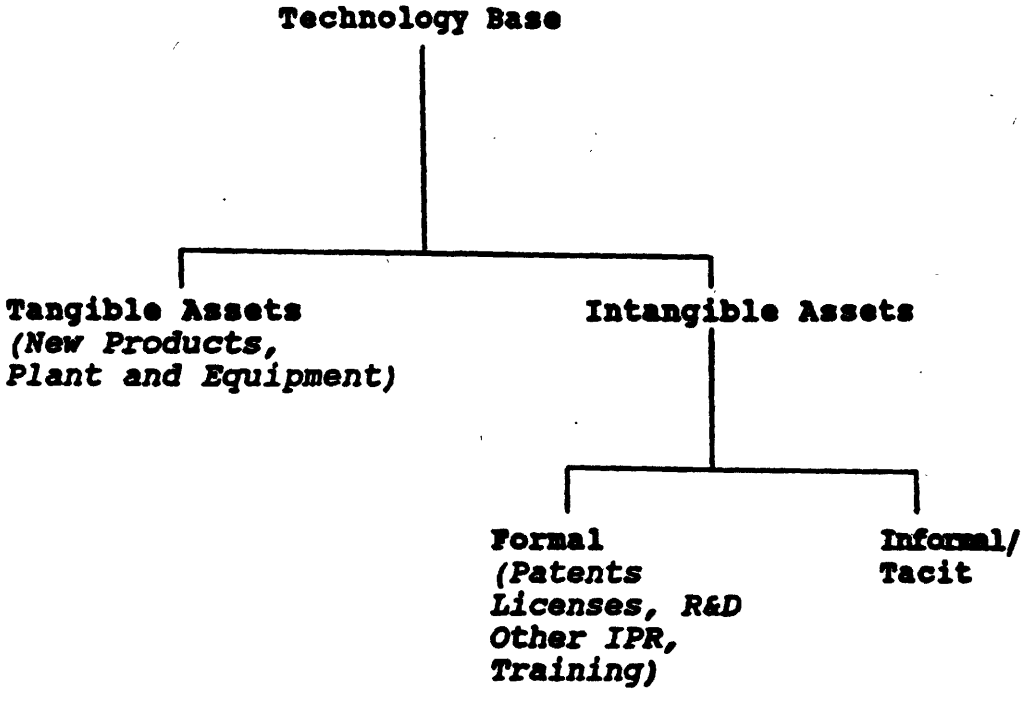
Just as technological innovation up until the 1960s was treated as an unexplained vasriance in economic growth and firm performance, so tacit knowledge as an element within technological innovation has, until recently, been seen in a similar way. Interest in tacit knowledge has grown rapidly as it has become increasingly acknowledged that the contribution of technological innovation to growth and economic performance is not just simply associated with embodied technologies, such as new plant and equipment, but is also highly dependent on disembodied, intangible assets and working practices. As such there has been a growing recognition that the performance of economies and firms are dependent on qualities and attributes that are tacit in form (David 1992, 9).

A central issue in any discussion about tacit knowledge is how it is defined and what are its key dimensions and attributes. This is because of the very reason that tacit knowledge is so difficult to define and quantify. It also explains why it has been a neglected subject for analysis, but also makes it of such interest. How is tacit knowledge defined? It is generally accepted that tacit knowledge, as distinct from intangible investment more generally, is non-codified, disembodied know-how that is acquired via the informal take-up of learned behaviour and procedures. Learning in an unstructured or semi-structured way is a key process within tacit knowledge acquisition and transfer. In discussing tacit knowledge it is important to posit it within the wider technology base of the firm (Figure 1). A major component of this is the tangible asset or reseource base of the firm evident in embodied technologies associated with new products, plant and equipment. However another major element is the firm's intangible assets. Many non-tangible assets and investments are formalised in terms of patents, licenses, research contracts or specific training programmes (Hall 1992, 136). Research has begun on trying to measure and evaluate these more accurately, led by the work of the OECD (1992, 114-133). As such tacit knowledge does not involve the generation and acquisition of tangible products and processes, or the more formal element of intangible knowledge flows associated with specific research, technical or training programmes.

However much of the discussion about what tacit knowledge is, has been influenced and based upon the work of Michael Polyani (1961;1962;1966;1967). Polyani (1966) describes tacit knowledge as involving two kinds of awareness- the *subsidiary* and *focal*. Whilst we might focus our awareness on a particular object or process we bring with that 'focal awareness' 'subsidiary awareness' which is in turn associated with two types of clues. *Subliminal clues*, which are clues we cannot directly experience ourselves (for example, a process which is too small to observe), and

Figure 1

THE TECHNOLOGY PROFILE OF A FIRM



marginal clues, which are marginal to our field of awareness or vision but which impart some information. Both sets of clues are not attended to directly contribute to the reality of the object on which attention is focused. In turn, the two types of awareness- subsidiary and focal - in combination are fundamental to tacit apprehension and (as in wider gestalt theory) provide a functional appreciation which would not be possible if they were taken in isolation. However although tacit knowing involves awareness it is also combined with 'subception'- learning without awareness (Polyani 1966). This process can be associated with scientific intuition and the issue of serendipity in scientific discovery. Elsewhere Polyani (1962) sums up tacit knowing as an act of 'indwelling', the process of assimilating to ourselves things from outside. It also involves more innate values though as well, such as skills. Thus "If I know how to ride a bicycle or keep afloat when swimming I may not have the slighteset idea of how I do this or even an entirely wrong or grossly imperfect idea of it and yet I go cycling or swimming merrily. Nor can it be said that I know how to bicycle or swim and yet do not know how to coordinate the complex pattern of muscular acts by which I do my cycling or swimming. I both know how to carry out these performances as a whole and also know how to carry out the elementary acts which constitute them, though I cannot tell what these acts are. This is due to the fact that I am only subsidiarily aware of these things, and our subsidiary awareness of a thing may not suffice to make identifiable." (Polyani 1966, 4).

In addition, it is generally accepted that tacit know-how cannot be directly or easily transmitted (Section 3), as knowledge and task performance are individual and specific and invloves the aquirer making changes to existing behaviour. 'Learning by doing' (Arrow 1962), 'learning by using' (Rosenberg 1982) and 'learning to learn' (Ellis 1965; Estes 1970; Argyris and Schon 1978; Stigiltitz 1987) are seen as critical elements within tacit knowledge aquisition. Above all, there are no clear market mechanisms which facilitate the transfer of tacit knowledge directly or by which it can be adequately measured. This former point has important policy implications (Section 4).

Academic and policy interest in tacit knowledge has come from two strands. One strand relates to work on technological innovation which has become increasingly interested in tacit knowledge through continued developments in trying to improve the measurement of technological change and in terms of its acknowledged role in industrial and corporate performance. Analysis here has focused either on specific technologies themselves or on a more macro-level basis trying to identify regularities between sectors or markets on their dependence on tacit knowledge for technical and competitive advantage.

The other strand has come from management and business studies investigating the management of change and core competences of the firm (see, for example,Winter 1987; Prahalad and Hamel 1990; Kay and William 1993; Grindley 1993) This interest has been heightened by the growth of Japanese competition and the spread of Japanese management techniques (Tatsuno 1993). The strength of Japanese

corporations was seen to reside not so much in research and development (R&D) or the scale and performance of the specific plant and machinery ('hard technology') but in the way these operations were managed and configured and in the skills and flexibility of the workforce (i.e. 'soft technology'; see, for example, Morgan 1990). Increasingly, however, the two strands of interest are coalescing together in terms of their interest in tacit know-how and technological competitiveness.

This paper seeks to provide an overview of existing research into tacit knowledge but more particularly to provide a more rigorous framework in which to analyse and codify the different dimensions and attributes of tactiness. It will lastly and most importantly seek to outline some of the key policy implications arising from this review.

2. Tacit Knowledge: Framework and Attributes

As noted earlier, there have been considerable advances in the measurement of embodied technologies associated with new porducts and processes. By contrast, tacit knowledge which is informal and non-tangible in character has still been largely neglected in the context of research and policy formulation. A major reason why this has been the case has been that tacit knowledge still remains a very nebulous concept and extremely difficult to measure and evaluate; even compared with formal, non-tangible assets. Section 1 provided a definition of what tacit knowledge is but this mainly defined what tacit knowledge was in terms of what it was **not**. To gain a better understanding of what tacitness is concerned with, it is useful to outline the different elements or attributes that tacit knowledge contains.

These key dimensions or attributes of tacit knowledge cover:

1) The different **forms** that tacit knowledge can take.

2) Tacit knowledge **acquisition channels** - what medium tacit knowledge is transferred and, related to this, the organisational/firm level of flows.

3) The **size and scale** of tacit knowledge transfer.

4) The length of **time and periodicity** of tacit knowledge flows.

5) The degree of **formality** of tacit knowledge.

6) The **time period** in the innovation process at which tacit knowledge is gained and utilised.

1. *The Different Attributes of Tacit Knowledge.*

As noted above, much of what is written to define what tacit knowledge is, is to describe what it is not, i.e. explicit knowledge. Tacitness is something that cannot be easily codified or learnt. More specifically, however, are there different types of, or dimensions to, tacit knowledge? Zander and Zander (1993) in their analysis of imitation and tacitness in two Swedish companies highlight the notion of degrees of tacitness based upon Polyani's three forms of tacit knowing. The first, the high speed and simultaneity of information processing may force a learner of a new skill to work out the details of the coordination for himself/herself. In this case, the actual performance cannot be slowed down and practising cannot be done slowly. In the second form it is sometimes difficult to articulate all that is necessary to master a skill since the action is embedded in the context. If one of the many context variables changes too much there will be no performance and all the 'ifs' cannot be meaningfully expressed. Lastly, the relationship between the details of a complex skill, even if artcuable one by one, is sometimes lost in language, which due to its serial nature cannot simultaneously serve to describe relationships and charaterise the things related. Zander and Zander (1993, 186) see this as leading to "our assertion that skills tend to be more articuable when the pace of the required performance is slow and pace variations are tolerable, when a standardised, controlled context for the performance is somehow assured, and when the performance as a whole can be truly cut down to a set of simple parts that relate to one another only in very simple ways."

Tacit knowledge therefore involves learning and skill but in a way that cannot be communicated in any direct, codified way. 'Learning by doing' and 'learning by using' (and also 'learning to learn') are therefore crucial elements in tacit knowledge acquisition associated with direct, on-the-job contact with new equipment, workpractice or operation. This directness is important at either a person-to-machine, person-to-person or person-to-activity basis. It is hard to conceive of situations where tacit knowledge can be acquired indirectly as this would involve some kind of codification and lack of direct experience.

2. *Tacit Knowledge: Generation, Acquisition and Organisational Flows.*

A key element, particularly in corporate strategy and policy debates, is how tacit knowledge can be acquired. Since tacitness is something very much to do with direct experience and is person-embodied it is not directly codifiable via artefacts. A firm or organisation can possess tacit knowledge through its workforce or via the operational milieu that exists and is created within the organisational structure. As such personnel within a firm can gain tacit knowledge via direct work experience in, for example, the production process, research laboratory or pilot plant. Tacit knowledge, however, is not a static stock of knowledge. It is continually being built upon and learnt, involving intuition and trial and error (although equally it can be forgotten; see Douglas 1987; Johnson 1992). This can include improvements and modifications to new technology in terms of plant and machinery aquired from outside the firm (associated with learning by using) or new machinery or workpractices, involved with

production or other corporate functions, developed within the firm (associated with learning by doing). In either of the two cases, although the technology may be acquired from outside the firm, tacit knowledge is gained from experiences **within** the firm.

Tacit knowledge, however, can also be gained from **outside** the firm. It can involve staff working off-site collaborating with other firms in the same industry or sector (horizontal collaboration) or via vertical collaboration backwards with suppliers, or forwards with firms further up the production or marketing chain. Tacit knowledge can also be gained via **intermediaries**, such as consultancies, that provide deirect on-the-job training or undertake, for example, diagnostic or trouble-shooting services.

As such the **organisational level** at which tacit know-how flows can occur is particularly useful in codifying support mechanisms and policy intervention levels. These can be classified as:

i) Intra-firm/intra-organisational flows - involving the movement and contact of personnel between sites and countries within the same organisation.

ii) Inter-firm flows: horizontal - relating to the movement of, and contact with, staff between different firms working in the same industry and collaborating with each other.

iii) Inter-firm flows:vertical - covering the links between staff from firms in different industries collaborating on the same product, process or technology field (associated with comakership, buyer-supplier, vendor and subcontracting links).

iv) Inter-institutional flows - involving links and staff flows between firms, higher education institutes (HEIs), public research establishments (PREs) and other intermediaries.

All these acquisition channels though they can cross firm or organisational boundaries are associated with largely person-embodied acquisition patterns rooted in direct on-site learning and experience. Since tacit knowledge cannot be easily codified or stored it can over time be forgotten by individuals. Similarly in a more general organisational context the conditions from which tacit knowledge can be gained can also be eroded over time if the right environmental context is dissipated. Tacit knowledge may also be lost by the hiring away of skilled staff by another firm.

3. *Scale of Tacit Knowledge.*

Much of the discussion about tacit knowledge has been about the individual. This is not surprising given that tacit knowledge is largely person-embodied. On this basis, is it appropriate to consider tacit operating at a firm level? Equally how far can a firm be said to have a clear tacit knowledge profile of its own? Certainly individuals as a group can be involved in jointly aquiring tacit knowledge associated with the working conditions of the firm and its collaborative links. Some forms of tacit knowledge may indeed be only acquired within a group, collective learning context. For example the working practices developed on the shopfloor, or in a particular research laboratory group. Many firms can be said to have such identifiable corporate cultures and learning capabilities (see, for example, Utrich et al. 1993) that these might be considered to form the basis for a more corporate-wide tacit knowledge environment that can be sustained and nurtured. Strategies and policies designed at improving tacit knowledge of the firm need to consider both the individual, group, site, business unit and firm levels. How can the working environments within each of these levels be developed which can be sustained and improved in relation to tacit knowledge learning? Firms also need to consider net flows of tacit knowledge to and from the firm; with ,for example, outward flows from the firm via the hiring away of skilled staff and inward flows through the recruitment in of new personnel. Considerations of scale are therefore crucially important here in terms of strategies and policies.

4. *The Timing and Periodicity of Tacit Knowledge Flows.*

The timescale and periodicity involved in personal contacts when transferring tacit know-how is also important. It can range from a one-off face-to-face meeting, through to temporary staff-secondment and on to full, long term relocation of research and technical staff (and hiring in of staff). Equally on-site training or inter-firm collaboration can also involve one-off, infrequent contacts through to lengthy, long term programmes involving large budgets.

5. *Tacit Knowledge Acquisition and Stage of the Innovation Process.*

Related to this dimension is the stage at which tacit knowledge is gained and utilised in the innovation and production is an important strategy and policy dimension. Thus tacit knowledge transfer can occur when:

-generating new scientific knowledge (associated with learning-to-learn);
-incorporating new knowledge in the design of a new product;
-when learning new production methods (learning-by-doing);
-or once the new product or process is being used by inside the firm or by external consumers (learning-by-using; see, for example, Slaughter 1993).

It is important to emphasise that tacit knowledge is gained throughout the innovation and production chain of a company, not just on the shopfloor associated with direct manufacturing operations. Tacit know-how is therefore gained and utilised throughout all functions and stages of a firm's operations.

6. *Formality of Tacit Knowledge Acquisition and Transfer.*

Although tacit knowledge cannot be formalised in the sense that it is codifiable or exactly reproducable nonetheless the conditions from which tacit knowledge can be acquired can vary substantially in terms of formality. They can range from planned on-the-job training schemes that are run by outside intermediaries to informal, chance contacts or via trial-and-error sessions by employees working on their own, perhaps in their spare time.

3. Tacit Knowledge: Imitation, Diffusion and Appropriability

It is a paradoxical that policies that have been targeted at tacit knowledge have been aimed at improving the diffusion of tacit knowledge between firm although it has been revealed that tacit knowledge has been a key **barrier** in the diffusion of technological innovation. A key element is that tacit knowledge is difficult to codify and that it is part of a long term, accumulated learning process that often proceeds more systematic scientific understanding of a technology or process.

Thus studies on the growth of the US commercial **aircraft industry** has highlighted the incremental developments in aircraft and engine design associated with learning by using during the course of aircraft operations and uncertainty involved in the complex integration of the whole range of aircraft subsystems. This can often be likened to a search process of testing and discovery. As such "a great deal of the knowledge that is important to the operation and improvement of a given process or product technology is 'tacit' that is, not easily embodied in a blueprint or operating manual" (Mowery and Rosenberg 1988, 9; see also Mowery and Rosenberg 1982; 1985). This helps to explain earlier observations of the industry in terms of the benefits of the steep learning curve associated with the increasing number of total airframes built by a particular aircraft company (Wright 1936). This view has been taken up in more detail by Vincenti's (1984) study of the aircraft industry and the development of flush riveting in airplanes. Here aircraft companies required practical 'trial-and-error', 'hands-on' experience (learning by using) to fully master the new technology and personal demonstration(Vincenti 1984, 563; see also Vincenti 1990).

Equally many of the early developments in the **pharmaceutical industry** were dependent not on sound scientific theory but on observation and 'feel' for what was right in terms of how patients reacted to new medicines (see, for example, Liebenau

1984; Swann 1988). Early work in, for example, the use of insulin for treating diabetes was based on the close observation of the effects of various pancreatic extracts on animals and humans (Swann 1988, 123). It was often only subsequently that scientific discoveries and advance were able to explain and systematise the initial observations and practice that arose out of them in medicine. This could also be seen in developments in **metallurgy**. As such "well into the twentieth century, metallurgy was a sector in which the technologist typically 'got there first', developing powerful new technologies in advance of systematic guidance by science" (Mowery and Rosenberg 1988, 33).

All these examples serve to indicate that science does not always precede developments in technology and production and that innovation is frequently associated with long term accumulated knowledge that is difficult to acquire. As such the very strength and importance of tacit knowledge is that it is often very difficult to be imitated by competitor firms. Work by Zander and Zander (1993) has revealed in the case of one innovation, a pulp flash dryer, that tacit knowledge (particularly in the critical area of dryer dimensioning which requires the exact tooling of different parts of the dryer) was important in reastricting imitators and proved to be highly effective in providing a long term, competitive advantage for the firm who initially developed it. However tacitness by itself may not always restrict imitation. In another example from Zander and Zander's study, a hydraulic rock drill, there were a large number of imitators in spite of a complex and partly tacit manufacturing process where reverse engineering and other methods to get hold of the production technology were strongly impaired. In the case of the pulp flash dryer a key factor reducing imitation was not tacit knowledge by itself but that this tacit know-how could not be held by individuals, or a small group of individuals, who could then leave and set up for themselves or work for rival companies. This was achieved by restricting the access and maintaining secrecy of the accumulated learning as far as possible through combining bits of tacit knowledge (in part through the eventual codification of some of the critical knowledge) from local sources into one central place, Sweden, and not allowing this information then to be dispersed back down to these local units.

Tacit knowledge may not, in itself, therefore provide the basis for gaining competitive advantage over existing and potential competitors. However in combination with making tacit know-how difficult to copy or replicate by competitors, via hiring away of key staff, reverse engineering or by other means of getting hold of tacit knowledge and accumulated learning, it can be a powerful element in a firm's wider knowledge base (Nelson and Winter 1982; Winter 1987; Dosi 1988) and competitive capability. For a firm to develop a successful strategy on the basis of its tacit knowledge skills it therefore needs to enhance these capabilities by a range of other measures that will protect them from imitation. Above all companies need to continually regenerate their tacit knowledge capabilities and enable them to captured and enhanced at a business unit or firm level, rather than allow them to reside in a few individuals or groups of people who may then leave.

For firms who have incrementally built up and developed such tacit knowledge capabilities, imitation and diffusion of this expertise and knowledge base to other firms will therefore usually be the last thing that they will want. By contrast for policymakers, imitiation and diffusion of tacit know-how is often seen as the key element in a strategy such as this to enhance and develop the overall capabilities of a local or national economy. Moreover the simplest and most effective way this may be achieved would be via firms with tacit knowledge capabilities to share their accumulated learning with other firms and/or to encourage the mobility of workers possessing tacit knowledge skills to move freely between firms with the aim of improving tacit knowledge flows that way. How can this apparent conflict be resolved, particulalry when implementing policies that may actually damage, harm or reduce the few 'lead' firms in an economy that possessd strong tacit knowledge capabilities and that are important in providing job opportunities and economic growth for the whole of the community? This issue will be addressed in the final section of this paper presenting the conclusions from this analysis and providing more specifically an outline of the policy implications of the work.

4. Conclusions and Policy Implications

What has this review and analysis revealed about tacit knowledge itself and in suggesting what potential there exists for developing successful strategic programmes in this field? Certainly a number of significant points have arisen from the analysis concerning tacit knowledge:

1) Firstly tacit knowledge will not in itself confer major technical and competitive advantages for a firm. If tacit knowledge can be acquired or imitated relatively easily the advantage conferred through the competitive process will not remain important for very long for the firm that has taken the lead in developing and acquiring it.

2) Secondly, the importance of tacit knowledge appears to vary significantly between sector, technology, market or product group (Metcalfe and Gibbons 1989, 164). The importance and relevance of tacit knowledge may indeed vary significantly within an industry or even between products produced by the same firm. More research needs to be undertaken on why these inter-industry and inter-frim variations in the importance of tacit knowledge exists, but it in turn would also help to reveal more about the nature of tacit knowledge itself.

3) Thirdly, the issue of imitation, forgetting and hiring away of key staff highlights the importance of viewing tacit knowledge in terms of a dynamic process of generation and flows that alter the total stock and profile of tacit know-how that a firm holds at any one time. Tacit knowledge should therefore not be seen as a static phenomenon but involves a stock of knowledge that is continually being added to through accumulated learning and eroded away via loss of staff, forgetting or through

other companies attempting to capture similar tacit qualities. As such what may be termed the 'competitive stock of tacit knowledge' a firm possesses involves:

-assimilation (inflow) of tacit knowledge from outisde the firm;
-changes in its own internal stock of tacit knowledge capabilities which varies according to its generation and accumulation (increase) of know-how learning as well as loss via institutional forgetting or misplacing; and lastly,
-via imitation (leakage) of tacit know-how to other firms.

It should be recognised that the actual stock of tacit knowledge a firm holds does not go down when it is imitated by other firms as information and knowledge once gained cannot be lost simply by sharing it (Stigler 1961; Lamberton 1983;although it can still be forgotten, abondoned or misplaced by the firm).

4) Fourthly, the time dimension is an important element when considering tacit knowledge. Here again although the actual stock of tacit know-how a firm possesses may be large its competitive stock of knowledge may not be large if it can be rapidly imitated by other competitors. The more a firm an therefore lengthen the period between imitation and 'catching up' by other firms of tacit know-how the more it extends its 'competitive stock of knowledge'. In essence it seeks to lengthen its quasi or temporary monopoly in the use of knowledge (Tiler and Gibbons 1991, 50).

5) Lastly, it is important to distinguish between tacit knowledge and learning at the individual and firm levels. Individuals are significant sources, conduits and generators of tacit knowledge, but a firm's tacit knowledge and learning base is not just simply the sum of its individual employees. There is organisational learning, as well as individual learning paterns, led by key teams of managers and decisionmakers throughout the firm which steer the cognitive development of the firm and help create an environment where tacit knowledge can be more successfully generated and sustained by individuals working within the firm. More particularly, as has been indicated earlier, the key components of how a new technology or product can often only be aquired and stored at the firm level; individuals, although they may have contributed to that store of knowledge will not be able to hold all the necessary information and know-how for its successful production and marketing.

In the preceding section the conflict between the objective of the firms, which seek to reduce the communicability and imitation of their tacit knowledge stock to maintain their competitive advantage, and the aim of policymakers trying to encourage the diffusion of tact know-how as much as possible between target firms, was raised. How can these apparently conflicting objectives be reconciled and what appropriate policy strategies can be suggested regarding the generation and transfer of tacit knowledge competences? A number of policy issues and strategies are worth noting here.

Firstly, is tacit knowledge the most appropriate or rewarding policy mechanism to enable the target group of firms to achieve long term technical and competitive performance? As has been indicated although tacit knowledge can be a key component in the technical competence of a firm this is not true in all sectors or technologies. Policymakers should consider whether strategies aimed at enhancing tacit know-how amongst companies is most appropriate for the set of firms it is targeting. Other initiatives may be more appropriate or the set of firms which are being targeted for tacit knowledge upgrading may need to be more tightly focused for resources to be most effectivley allocated.

Secondly, although there has been emphasis in policy terms on spreading tacit know-how between firms, tacit knowledge enahncement programmes may be more effectively targeted at tacit know-how generation within firms. As has been shown, at least initial evidence suggests that tacit is highly specific not only at sector or technology level, but also within individual product groups or similar production processes. What may work for one industry, or one firm within an industry or indeed one product being manufactured by a firm may not work for other industries, firms or products. Thus there might have been too much emphasis in the past on trying to transfer tacit knowledge from other firms instead of 'starting from scratch' by looking at a frim on its own and deciding what existing tacit knowledge capability it has and what improvements could be made to build up and enhance its accumulated learning and tacit know-how competence. This could be part of a wider programme to improve the learning process across the organisation (Itami and Roehl 1987). Consideration should also be given to how a firm can defend its competitive stock of tacit knowledge, thereby extending its temporary lead and response times over its competitors. On this basis one such programme that would complement such an approach would be to set up a 'tacit knowledge task force', made up of individuals seconded from other firms with good tacit knowledge records that would visit individual firms and factories to advise on developing a good competence in tacit knowledge acquisition and generation which would provide a long term tacit knowledge strategy for the enterprise.

Firms can be encouraged to share their tacit knowledge and learning skills with other firms in certain circumstances but rarely if ever with firms in direct competition to them. Obviously not all firms are competitors and indeed sharing tacit skills may have long term benefits to the providing firm. This relates most directly to sharing know-how with firms that are vertically related to the sharing or providing firm. This would involve firms which the tacit 'donor' company has backward or forward linkages with associated with the same sector or technology. A number of lead firms, mainly from Japan but also latterly from the US, already seek to help their suppliers to achieve their corporate quality supply standards, or to speed up production and timeliness of delivery. Companies may also be supported to share their tacit competences with firms more generally but external to their specific market ('non-rival firms'; Von Hippel 1987, 301; see also Von Hippel 1988). Here firms may be encouraged to participate as part of their wider corporate responsibility to the local community or to support their regional or national economy. Such sharing of

information and knowledge would be more general in nature, but may provide guidelines to participating firms in how they might adapt such principles to their particular situation. Lastly, in this context, firms may be helped to share tacit know-how even on a horizontal basis with firms in the same industry or product market. This is likely to be more unusual but may occur between Small and Medium-Sized Enterprises (SMEs) or local companies operating in the same industry or technology sector who may be willing to share tacit information on a limited basis to help compete against larger, more powerful companies, often from overseas. Identification of such a common threat may galvanise such smaller companies into at least some mutual cooperation.

The distinction between tacit knowledge learning and aquisition at the individual and firm level was made earlier. Tacit knowledge strategies could instead of focusing on the firm could target individual workers. Here schemes could take workers from a range of organisations and take them as a group (or seperately) outside their own workplace to develop and refine their tacit skills and learning processes as individual workers. Although this may not directly help the firms themselves in the short run, it would seek to create a local or sector specific set of tacit talent that should provide long term benefits to firms as workers go and apply what they have learnt and acquired to their own organisation or indeed other organisations. Sometimes the process of moving workers from one job environment with its own set of innate tacit skills to a different working environment may facilitate this tacit knowledge transfer but also enhance new tacit know-how learning as well. Indeed one of the oldest schemes associated with tacit knowledge transfer, the teaching Company Scheme (TCS), set up in the UK focused on this approach by transferring workers empolyed in universities and transferring them to firms. The 'associate' was then jointly supervised by academics and industrialists on a specific project within the firm. In essence, therefore, the TCS is "a mechanism designed to promote the movement of tacit knowledge from the site of its production to commercial enterprise, with the explicit aim of translating this knowledge into terms which will help the enterprise solve key problems" (Tiler and Gibbons 1991, 51).

All policy programmes and strategies aimed at improving tacit knowledge learning and skills of firms are difficult to establish and implement by the very nature that the focus of such policies, tacitness, is difficult to codify, standardise and transfer. However although it should not be seen as a panacea for all economic ills it does represent a valuable tool for many firms to enhance their competitive and technical profile and does not require vaste amounts of new resources or funding to be put in place to make substantial improvements in industrial performance.

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THE ROLE OF POLICY IN SUPPORTING THE ACQUISITION DIFFUSION AND PROTECTION OF TACIT KNOWLEDGE

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I. TACIT KNOWLEDGE AND MODELS OF TECHNICAL CHANGE

Technical change can be analyzed at two levels: within specific firms and at the aggregate economic level of a region, nation, or even the world. The results of empirical studies of how the innovative process is organized within firms have frequently influenced aggregate models of technical change because of the central role of the firm in developing and diffusing innovations. Consequently, historical changes in how firms organize innovation can influence aggregate models of technical change. This connection between a specific historical context and a particular model of technical change indicates that the change from simple to more complex models, as documented in several reviews of the history of models of technical change, partly reflects not only an improvement in our understanding of technical change, but also, to a significant extent, changes in the social, economic, and technological conditions under which technical change occurs[1]. Both firm-specific and aggregate models can also contain a normative component by pointing towards methods which are believed to improve the organisation and efficiency of innovation, rather than describing how innovative activities are actually organized in a particular country and time period.

Stage Models of Technical Change

The standard approach to modelling innovation is to divide the process of technical change into several independent stages. The stages usually consist of basic research which produces new scientific discoveries, applied research where scientific discoveries are developed into new inventions, market experimentation where inventions are further developed into innovations, and finally, the diffusion of the innovative product or process throughout the economy.

The simplest and most widely-known stage model of technical change is the basic linear model that became prominent in the 1950s. The model represents technical change as a series of sequential steps, starting with basic research and ending in the diffusion of a fully-developed product or process. The basic linear model has been metaphorically compared to a pipeline because it suggests that an increase in the flow of upstream or

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[1] For reviews of the history of models of technical change, see Forrest (1991), Ziman (1991) and Rothwell (1992).

supply-side inputs into the pipeline will directly increase the number of new marketable products and processes flowing out the downstream end. The conclusion that can be drawn from this model is that the most important government policy is to support supply-side factors such as basic and applied research[2].

In the late 1960s the goal of innovation and technology policy partly shifted from the support of supply-side projects to meet government-defined goals towards policies to improve the competitiveness of private industry[3]. The concern for competitiveness led to several new versions of stage models which included downstream or demand-side factors to pull or draw innovations through the various stages. The firm-level demand model that was equivalent to the basic linear model simply changed the direction of the arrows so that the innovation process began in market demand, as measured by the diffusion of a product, and ended in new applied research[4]. Later stage models included both supply and demand factors while retaining an emphasis on sequential change and relatively isolated stages of activity. More advanced models included both demand and supply factors and recognized the possibility of bottlenecks occurring at or between the stages of the innovative process.

The strength of stage models lies in the division of the innovative process into several discrete and identifiable stages. These stages reflected the traditional division of the innovative process within firms into separate departments such as R&D, production, and marketing. Aggregate stage models provided policy makers with a taxonomy of technical change that could be used to develop interventionist or support programmes to alter conditions at a specific stage. For example, the emphasis in the basic linear model on supply-side factors provided policy makers with a useful guide for the support of mission-oriented projects to develop civilian nuclear power, the Apollo space program, or military

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[2] Rothwell & Dodgson (1992) comment that this model of technical change also influenced the behaviour of private firms.

[3] Freeman (1991) comments that technology policy has gone through several phases. The phase of mission-oriented research began in the late 1940s and continued into the early 1960s. The end of this phase partly overlapped with a period from the 1960s to the late 1970s when the main concern was with competitiveness.

[4] See the discussion in Rothwell (1992) or the example in Prakke (1992), who presents a linear demand model to highlight the importance of demand in shaping the innovation strategies of private firms.

equipment. These projects were supported by massive government expenditures in basic and applied research in order develop products that met technical performance objectives and did not have to meet demand or market-driven criteria. More complex stage models that incorporated bottlenecks and both demand and supply-side factors suggested three types of government policies: subsidies to increase the supply of basic research, competition and other policies to prevent bottlenecks during the stage of applied research and market experimentation, and policies to create demand-pull, either through government procurement, regulation, or programmes to support the wider diffusion of a technology and its applications.

Systems Model of Technical Change and the Importance of Tacit Knowledge

Stage models focus on each of the specific stages and tend to ignore *how* each stage is linked with another stage. Each separate stage is, in effect, considered in isolation from activities in other areas, including its upstream and downstream partners. However, empirical research, including both case studies of the organisation of innovation within firms and studies of technical change at an aggregate level, have shown that how the stages are linked has a significant impact on technical change. For example, research on how successful innovative firms in Japan, the US and Europe organize technical change indicates that many of these firms use integrated development teams which span the traditional division into R&D, production, and marketing. Integrated development techniques were noted in empirical case studies from the late 1960s in advanced industrial laboratories, but these methods have since

Table 1

Expected Competitive Benefits to Firms from Closer Internal and External Linkages in the Innovative Process

1. *Shorter development times for innovations.*
2. *Increase in the number and quality of innovations.*
3. *Reduction in costs and financial risks, due to the increasing complexity of R&D, through collaboration with other firms.*
4. *Increase in technological opportunities from linking several technologies to develop innovations based on "technological fusion".*
5. *Improved transfer of tacit knowledge and better user-producer relationships through networking.*

been studied in a large variety of firms[5].

Integrated development techniques increase the density of links *between* two or more stages and imply a gradual disintegration of the boundaries that separate one stage from another. Similarly, research on technical change at an aggregate level has noted an increase in collaborative alliances between companies to share R&D expertise, costs, or to investigate opportunities through the fusion of different technologies[6]. Linkages or networks have also developed among and between public and privately-funded R&D laboratories. These alliances act to increase the density of links *within* a particular stage. Tighter linkages between and within different stages appear to have been partly undertaken by private firms in order to improve their competitiveness. Table 1 summarizes several benefits to firms from organising innovation around close links between the different stages of the innovative process.

Empirical studies also show that technical change does not develop over time through a series of sequential stages, as indicated by many stage models. Instead, technical change is a complex process which contains both cumulative feedback loops and multi-directional links. A few examples of feedback loops and linkages which fall outside of the pattern predicted by linear stage models are given in Table 2.

The existence of a large variety of multi-directional links and cumulative effects suggest using a systems approach to technical change which focuses on the *interactive links between different stages and the composition of these linkages.* This approach also assumes

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[5] See, for example, Morton's (1967) study on innovation in the Bell Labs in the 1960s. For several recent case studies, see Corcoran (1992). There is an extensive discussion in the innovation management literature, much of it inspired by the success of leading Japanese firms (Rothwell, 1992), of the need for firms to develop new innovations through R&D teams that span several stages of the innovative process and include personnel from both research and management. For example, Frey (1989) advises managers to 'junk their linear R&D' model and to adopt integrated development techniques in order to shorten product development times and develop a competitive lead over other firms. Firms that partly owe their success to reducing the boundaries between several stages in the innovative process include Hewlett Packard, 3M, Canon, and Honda. See, for example, Van de Ven (1986), Peters (1983), Quinn (1986), and Imai et al (1985).

[6] For an empirical study on networking and alliances between firms, see Hagedoorn & Schakenraad (1992) and for a review of networking see Freeman (1991). In regards to technological fusion, Kodama (1992) suggests that the rewards from collaborative R&D may be far greater from projects which combine or fuse several unrelated technologies than from collaborative projects based on one technology.

that the process of technical change must be understood as a whole instead of as a series of isolated stages.

Table 2

Feedback Loops & Linkage Effects

Feedback loops:

- *An increase in the number of users of a network technology makes it more attractive to non-adopters, leading to further increases in the number of users.*
- *The expectation of an improved product in the short-term future slows diffusion and lowers profit rates, leading to a delay in the introduction of the expected improved product.*

Linkage effects:

- *Problems encountered in applied research stimulate new basic research.*
- *New innovations in scientific equipment which reduce the cost of basic and applied research.*

A systems approach to technical change developed in the 1980s, partly in response to studies on the organisation of innovation in successful innovative firms[7]. An early "interactive" model described the process of innovation within the firm as a "complex net of communication paths, both intra-organisational and extra-organisational, linking together the various in-house functions and linking the firm to the broader scientific and technological community and to the market-place"[8]. This emphasis on communication paths is similar to the systems approach taken here, but there are two important differences.

First, the systems model developed below carefully considers not only particular stages or activities such as applied research, design, or the production of a prototype, but also the role of different actors in technical change. These actors consist of both individuals such as scientists, engineers, technicians and marketing staff and the institutions involved in technical change, including public and private institutions such as production plants, research institutes, and universities. Second, and more importantly, the systems model

[7] See for example, the firm-level systems model of Rickards (1985). Rothwell (1992) reviews several firm-level systems models that were developed between the late 1970s and the late 1980s.

[8] Rothwell and Zegveld, 1985, cited in Rothwell, 1992. Rothwell later develops the integrative model into what he defines as a "systems integration and networking model". This is a normative model which points out how innovation should be organized in the future.

closely examines the structure, composition and organisation of the "communication paths". This leads to the recognition that the cumulative creation of knowledge through learning plays a central role in technical change. This role requires greater elaboration.

The communication paths that link different activities and actors are made up of *information flows* and more importantly, by the transfer of *knowledge*. Information can take three forms. It is contained in artifacts such as equipment, instruments, and materials that are used in production; it is available as data or in written documents such as reports, journal articles, and books; and it is held by individuals. The first two forms of information are characterized by the fact that they are not tied to any particular individual because they are available in a codified form. However, of greater importance to innovation is knowledge, which is often tacit in the sense that it is not available as codified information[9] and by definition, is held by individuals. Knowledge is the essential requirement for technical change since it encompasses the know-how, skills, and experience to innovate. Knowledge is obtained and increased through a process of learning; from codified sources of information, from direct experience as a result of doing, or from other individuals as a result of interacting[10]. The development of knowledge through a range of activities based on learning is defined here as a process of *assimilation* while the ability of firms to apply assimilated knowledge to productive uses is defined as the absorptive capacity of a firm[11]. Since knowledge frequently cannot be obtained from codified information, the most effective means of linking different activities in the innovation process is often through direct contacts between knowledgeable individuals.

This accumulation of knowledge over time as a result of learning is one of two essential factors that drive technical change. Given the capacity within public or private firms to

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[9] Dasgupta and David (1992) argue that the proportion of knowledge which is not available as codified information partly reflects the costs and benefits of codification and disclosure compared to non-disclosure.

[10] For an extensive discussion of the importance of learning to technical change and for a taxonomy of learning, see the articles by Lundvall (1992) and Johnson (1992) in Lundvall (ed) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. The book builds a theory of innovation based on learning which has many similarities with the systems perspective provided here.

[11] The definition of absorptive capacity follows Cohen & Levinthal (1989; 1990) who examine the role and ease of learning in the development of absorptive capacity.

assimilate information, knowledge will gradually build up over time as more information is obtained and understood from either internal or external sources, permitting further technical developments and the exploration of new solutions to a problem. The other essential factor is the system of institutional and economic incentives and disincentives that direct and guide the search for new knowledge into economically profitable areas.

Table 3

Main Characteristics of a Systems Model of Technical Change

1. *Multi-directional links at the same point in time between the stages of technical change.*
2. *Cumulative processes over time can lead to feedbacks and lock-in effects.*
3. *Technical change is dependent on knowledge and the assimilation of information through learning.*
4. *The details of the development path and diffusion process for each innovation are unique.*
5. *Technical change is an interdependent and systemic process.*

The focus within a systems approach on information, learning and knowledge requires an addition to the meaning of diffusion used in stage models, where diffusion is defined as the physical diffusion of a new product or process technology. The systems approach adds the diffusion of information and knowledge. In this respect the systems approach emphasizes that the transfer of the ability to assimilate new technologies through learning is a necessary complement to the physical diffusion of new products and processes. For example, the transfer of a technology across regions, such as within a country or between developed and less-developed countries, is dependent upon the transfer of the ability to use a technology between different actors, for example from researchers working in university laboratories to researchers working in the R&D departments of private firms. In addition, the multi-directional and cumulative characteristics of technical change, combined with differences in the accumulation of knowledge and a wide range of historical and regional factors, ensure that the details of the development and diffusion of each innovation are unique.

General Policy Implications of the Systems Model for Diffusion Policy

Stage models of technical change suggest policies to strengthen each of the stages and

to ensure that there are no bottlenecks hampering the development of an innovation as it proceeds through these stages. The change from a stage to a systems model does not imply that all stage-specific interventions are no longer necessary. Instead, the adoption of a systems perspective requires a change in emphasis from policies to strengthen specific stages to policies to strengthen the *process of technical change as a whole*. This perspective also suggests developing the implications for policy on the basis of the characteristic features of innovation as a process, rather than focusing on the object - each individual innovation - or on the range of available policy instruments, such as financial subsidies, procurement, or regulations.

Five main characteristics of a systems approach to technical change are summarized in Table 3. Each of these characteristics is of direct relevance to diffusion policy. First, the existence of multi-directional linkages at the *same point in time* raises the need for communications infrastructure and networking to promote the circulation of information and knowledge among the various actors and activities involved in innovation. Second, the cumulative features of technical change that develop *vertically over time*, much of which is due to the accumulation of knowledge, point to the need for policies to promote virtuous cycles and the diffusion of beneficial technologies. Third, the importance of knowledge and learning stresses the fact that the successful diffusion of many new technologies depends on the availability of skilled and knowledgeable individuals. Fourth, the uniqueness of each innovation suggests the need for customised policies adapted to specific conditions, in addition to broader policies to support technical change in general. The fifth characteristic, largely the sum of the other four characteristics acting together, is the emphasis on technical change as a systemic and interdependent process. This characteristic implies the importance of developing complementary, mutually reinforcing policies that work to achieve a common goal, as well as the need for coherent policy design to avoid conflicts among policies that are aimed at different goals.

The effect of each of these five characteristics on diffusion policy are briefly outlined below. ~~More extensive discussions are provided, where relevant, in Chapters Three and Four.~~ The policy implications ~~in this Chapter~~ are further divided into policies which address technical change at an aggregate level and at the level of the firm. This division is provided as a rough guide to the most important policies that are suggested by each

of the five characteristics, but it is important to note that many policies will affect technical change at both the aggregate and firm-specific level. Table 4 provides a brief

Table 4

Implications for Diffusion Policy of a Systems Approach to Technical Change

Major Characteristic	*Aggregate Policies*	*Firm-specific Policies*
1. Multi-directional linkages at the same point in time	• *Provide developed communication and transport systems* • *Support networking and cooperation among and between research institutions and firms and the infrastructure of supporting services*	• *Support research and education that improve the organisation of innovation*
2. Cumulative process over time	• *Design policies to minimize undesireable linkage and feedback loops* • *Force a switch from diversity to standardisation when needed* • *Policies to support faster diffusion rates if of benefit*	• *Policies to assist firms in unlearning when needed and to develop new areas of expertise*
3. Dependence on knowledge and the assimilation of information	• *Maintain an educated and skilled workforce* • *Support transfer and interdisciplinary sciences*	• *Provide support for the retraining of staff* • *Technology transfer and demonstration programmes*
4. Each innovation is unique	• *Broad range of programmes to support diversity* • *Appropriate mix of both general and specific policies*	• *Preserve a diversity of future options by nurturing the technological capacity of firms* • *Develop customised programmes to deal with the specific needs of SMEs*
5. Interdependent system	*Ensure complementary and coherent policies*	

summary of the aggregate and firm-level implications for diffusion policy of each of the five main characteristics of the systems model.

1. Multi-directional Linkages: Aggregate level policies

Communications Infrastructure: Effective policies to ensure the unobstructed and rapid flow of information and knowledge are necessary in order to connect different actors and stages in the process of technical change. A basic need is for well-developed communication and transport systems to provide the physical infrastructure for the intangible system of formal and informal networks which link individuals working for different institutions and firms[12].

: Firm-specific policies

Information and communication technologies provide a powerful tool for improving the productivity of innovation by increasing the ability of firms to access information and to form networks. Yet, the potential of these technologies is often constrained by inadequate organisational structures, both within firms and between firms and other actors involved in technical change. Future improvements in the innovative capabilities of both firms and public institutions will, in many cases, require organisational innovations. The ability of many industrial and service sectors to reap productivity benefits from new information technologies is also dependent on organisational innovations. Governments can support organisational innovation by funding organisational research and education.

2. Technical Change as a Cumulative Process: Aggregate level policies

Linkages and lock-in effects: The continuous accumulation of knowledge, combined with the effect of institutional and economic incentives in directing the search for innovations towards profitable directions, leads to the gradual development of areas of technological expertise or specialisation among individual actors, firms, and regional clusters of firms and public institutions. Specialisation as a result of cumulative experience with a particular technology can be of immense benefit and promote virtuous cycles of

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[12] At the extreme, the importance of multi-directional links for the transfer of information and knowledge suggests two main government policies to support innovation: the development of an extensive high quality telecommunications infrastructure and the supply of large numbers of skilled scientists and engineers. This approach appears to have been taken by South Korea and Taiwan. For example, the number of scientists and engineers in South Korea has grown explosively from 4,157 in 1953 to 361,920 in 1987. This increase will continue in the future because of a continuing high level of investment in engineering and science education. The percentage of the Korean population which were engineering, science or maths students in 1987 was 1.3% compared to 0.74% in Japan (Kim, 1991).

development that can result in radical new technologies and lower production costs, but cumulative effects can also lead to lock-in into a technology that is inferior to alternatives or which becomes obsolete at a later date, leading to the need to unlearn earlier knowledge and develop new expertise[13]. Cumulative effects can be caused by linkages and feedback loops, for example between the accumulation of knowledge and economic incentives.

Linkage effects occur when a policy which is intended to affect one area unintentionally spills over to affect another area. An example of a linkage effect which is relevant to diffusion is the connection formed by appropriability conditions between R&D investment by private firms and diffusion rates. For example, intellectual property rights and patents are designed to stimulate investment in R&D by allowing the innovator to appropriate temporary monopoly profits. At the same time, these policies, as a result of increasing the market price of an innovation, will reduce the rate of diffusion and lower the social benefits of the innovation. Micro-economic simulation models of this problem show that there is an optimum level for the strength of appropriability conditions which maximizes both investment in innovation and the social benefits of diffusion[14]. The problem for policy makers is to find the approximate location of these levels for economic sectors where government regulations, for example on patents and intellectual property rights, are an important influence on appropriability conditions[15].

Feedback loops occur when the outcome of an action loops back to affect the original

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[13] Lock-in commonly occurs as a result of increasing returns to scale, so that one technology develops large advantages that allows it to dominate and eventually replace a competing technology. For example, the usefulness of a computer operating system is dependent on the number of software applications, which in turn is dependent upon the number of users. A virtuous cycle can develop in which an increase in the number of users increases the size of the market and leads to more software applications, and hence even more users. See David (1985) for an historical example of lock-in to the sub-optimal QWERTY keyboard and Arthur (1988) for a mathematical explanation of how lock-in to an inferior technology can occur.

[14] This effect is illustrated by Chiaromonte & Dosi (1992) in a microeconomic simulation model of the behaviour of innovating firms in response to different appropriability conditions. The model shows that the ability to appropriate the profits of an innovation is necessary for firms to invest in innovative activities which result in aggregate growth. Too high appropriability conditions, however, reduce diffusion rates and consequently reduce aggregate income and productivity growth. For a review of the literature on optimal patent life, see David (1992) Kaufer (1989).

[15] Questionnaire studies indicate that patents are of importance to the chemical, pharmaceutical, and uncomplicated mechanical equipment sectors (Levin et al, 1987).

action itself by either increasing or decreasing its strength. Network technologies which increase in value with the number of users frequently benefit from self-reinforcing feedback loops. For example, the value of a telephone system to potential subscribers increases with the number of subscribers, so that an increase in subscriptions will continually increase the value of the network and attract additional subscribers (though often with diminishing returns per additional subscriber after some point). Feedback loops can be very beneficial, but they can also result in lock-in into a specific technology because of economies of scale made possible by a large number of users combined with substantial levels of investment in existing equipment or skills. The problem for policy makers faced with cumulative processes is how to identify and encourage the diffusion of beneficial or superior technologies and to discourage the diffusion of harmful or inferior technologies.

Diversity and standardisation: Technical change is based on the exploration of a wide range of technical options. Over time, the cumulative characteristics of technical change can lead to a reduction of diversity and to a loss of potentially beneficial technologies. This suggests a need for policies to maintain diversity, but at some point in time, particularly for network technologies such as distribution, transport, or telecommunications systems, diversity can decrease benefits by preventing economies of scale, a reduction in costs through intensive learning about a technical option, and the potential for network externalities[16]. The problem for policy is to determine when and how to maintain diversity and when and how to encourage a shift to standardisation, for example through regulation, to reduce diversity.

For many technologies, market processes will lead to the development of *de facto* standards which reduce diversity without the need for government intervention. In other cases, policy intervention may be needed to limit diversity through government regulations to establish *de jure* standards or product compatibility requirements in order to permit faster diffusion of a preferred technology. Standards and product compatibility promote diffusion by minimizing information costs and the risks of early adoption for the buyers of new products and processes. They can also accelerate the development and

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[16] See David, 1992a.

diffusion of complementary equipment and services. Compatibility, either due to *ex ante* standards or *ex post* reliance on converter or gateways technologies, increases flexibility, experimentation, and diffusion by ensuring that new equipment and software can be productively combined with existing stock. For example, converter technologies to link different network systems and regions will increase the number of potential users and consequently improve both the diffusion of these technologies and the information that these technologies are designed to carry.

Rate of diffusion: The rate of diffusion is dependent on cumulative effects such as the development of knowledge about a technology and its use. In most cases diffusion rates are best determined by market factors, but in other cases there could be a role for policies to increase the rate of diffusion, for example for technologies with important positive externalities or social benefits.

Agglomeration effects: The accumulation of experience by a number of related firms or institutions in a locality can lead to agglomeration effects where technological expertise is concentrated in a geographical region. This agglomeration can be reinforced over time by the importance of personal contacts to learning, a growing supply of skilled labour, the presence of demanding users, and the development of networks between firms, institutions, and users[17].

:Firm-specific policies

Firms need to develop virtuous cycles of learning in economically valuable areas of technological expertise. Many of the foundations for this process are provided by access to a range of factors that are discussed elsewhere, such as access to skilled labour and good communication links with both users and suppliers. The problem in this area is to develop policies that can assist firms to break-out of specialisation in a technological area of declining value, or to "unlearn" past skills so that the firm is capable of learning new ones.

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[17] On the implications of these effects on the dynamics of regional growth, see David & Rosenbloom (1990).

3. Knowledge and Learning: Aggregate Policies

Provision of Skilled Scientists and Engineers: The diffusion of information in whatever form, for example in new equipment, electronic data or printed articles, is of little value unless this information can be assimilated by firms. The importance of knowledge, skills and experience and the need to assimilate information through learning points directly to the importance of a skilled workforce, particularly scientists and engineers, who can acquire the necessary knowledge to develop, adapt, and apply innovations.

A good educational system is a vital component in the maintenance and development of a skilled workforce. Education can provide both practical skills and the ability to assimilate the results of other research. For example, the publicly available results of basic research cannot be assimilated by firms or other institutions without individuals who are trained in basic research and therefore able to understand and use the results[18].

Skills and knowledge can also be supported through formal and informal networks for sharing knowledge among individuals working in both private and public organisations. Another means is to provide practical experience and opportunities to develop knowledge through learning-by-doing. Most of this occurs within firms, but governments can also support learning-by-doing through public research institutions.

Transfer and interdisciplinary sciences: Transfer or applied sciences[19] create a bridge between basic research and practical needs. They are an essential means of transferring knowledge between different areas of research and consequently need strong governmental support. Similarly, interdisciplinary sciences that can link, for example, both

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[18] See Pavitt (1991) for a discussion of the value of government support for basic research in order to produce trained researchers and to attract downstream development of technological and production activities. In addition, David, Mowery and Steinmueller (1992) argue that both the negative and positive results of basic research are of value by providing knowledgeable researchers with "maps" that can guide the search for commercially beneficial new technologies; both by indicating where and where not to undertake costly exploratory R&D.

[19] Transfer sciences include engineering disciplines such as mechanical and electrical engineering and optics, disciplines concerned with information technology, chemistry-related fields such as materials science and chemical engineering, and life sciences such as medicine, pharmacology, agronomics, and soil science. For a more extensive list and an analysis of the importance of transfer sciences, see pp. 35-37, OECD, 1991.

natural and social sciences could play an increasingly valuable role in finding solutions to organisational and environmental problems.

National versus supra-national systems of innovation: The ability to assimilate information, much of which can only be learned through direct personal contact, is maintained and strengthened by both formal and informal networks between R&D workers and by educational and public research institutions. These networks and institutions are usually an integral part of a national system of innovation which, in turn, is partly defined by a common language, educational system, and academic and business culture. The importance of national systems of innovation raises questions about the effect of supra-national innovation policies and the application of the subsidiarity principle.

Firm-level policies

Supporting a Skilled Workforce: Policies to increase industrial competitiveness must ensure that firms have access to an adequately skilled workforce that can both develop innovations within the firm and assimilate new techniques that are developed outside of the firm. This is unlikely to be a problem for large firms as long as the educational infrastructure provides a supply of trained graduates. On the other hand, under certain conditions there may be a role for government policies to subsidize the employment of scientists and engineers by SMEs (Small and Medium-sized Enterprises) or to subsidize training programmes to upgrade the skills of a wide variety of workers who need to use new technologies.

Many SMEs do not have the financial resources to continually search for potentially beneficial applications of existing or new technologies. One option is provide this type of information through innovation centres or technology outreach programmes. Depending on the technology and the industrial sector, these programmes can be designed to either reach a wide range of SMEs or to assist specific target groups of SMEs [20].

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[20] See for example, the discussion of this topic by Nooteboom et al (1992). The Clinton Administration in the United States has also announced plans to establish 170 technology centers to provide technical support to SMEs.

4. The Unique Pattern of Innovation: Aggregate policies

Creating Diversity: Basic research is a vital source of a diversity of new ideas and innovations. However, the uniqueness of each innovation indicates that innovation support programmes should maintain diversity by supporting other sources of innovation such as demand-side factors, applied research, or the development of new scientific instruments which can open up new technological opportunities[21]. Support for some of these areas must be carefully evaluated to ensure that public funds are used effectively and do not replace private investment. In some areas, for example in applied research, there may be a limited range of areas where public funding is needed. In other areas such as the creation of demand, there may be a wide range of useful policies based on procurement to encourage innovations.

Specific policies: The unique character and development process for each innovation indicates that few, if any policies are universally appropriate for all innovations and under all conditions. This problem can partly be overcome by a mixture of general policies which are appropriate for a wide variety of technologies and by more focused policies which are designed for specific technologies or which can flexibly adjust to changing circumstances. The ability to develop policies that are adapted to specific conditions increases with proximity to the object of policy. This raises the question of subsidiarity, or the most appropriate level of government - regional, national or supra-national - for the development and management of specific policies.

:Firm-specific policies

Preservation of diversity: The uniqueness of the development process for each innovation is matched by the uniqueness of its use by firms. No two firms will use, develop, or understand a particular technology in the same way and each firm will combine different technologies together in idiosyncratic patterns[22] in order to match the technology with their social, technical, and economic needs and capabilities. This means that technological options cannot be preserved by the support of public research institutions alone. The

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[21] For a discussion of the role of scientific instrumentation in new technologies, see De Solla Price (1984) and Irvine (1991).

[22] See Clarke (1992).

maintenance of a diversity of options requires nurturing the technological capabilities of firms.

5. Interdependent and Systemic Process: Complementarity and Coherence

The systems approach indicates that technical change is an interdependent and systemic process in which activities in one area can affect a wide range of other activities. The complexity and interdependence of technical change requires both *complementary* and *coherent* policies. Some goals cannot be reached without several complementarity or mutually supporting policies. For example, programmes to support technology transfer to SMEs that have had little experience in assimilating new technologies could be an expensive failure without complementary policies to improve the ability of SMEs to develop or acquire a skilled workforce or to access adequate sources of finance. Coherence requires that policies with different goals do not conflict with one another. For example, science and technology policies to support the goal of increasing the competitiveness of European firms should not conflict with other economic and social goals such as a reduction of regional disparities within the EC.

Concluding Comments

The complexity of innovation requires a systemic approach that encompasses the entire process of technical change and in particular the essential role of tacit knowledge. This paper has briefly outlined the five main characteristics of a systems approach and the implications of each one for diffusion policy. This leads to a wide range of potentially useful policies, as outlined in Table 4, but the complexity of technical change means that not all policies are relevant to the same degree for all economic sectors. The most appropriate mix of policies will vary depending on the competitive environment, the technological opportunities available to the sector, and the relative importance of private and public goals. However, one of the most important general conclusions that can be drawn from a theory which views technical change as a dynamic process is the need for policies to support the capacity of organisations and firms to innovate and change through continual learning. Diffusion policies are an essential component of this support and include policies to provide infra-structural support, to improve the accumulation of knowledge, often tacit in nature, and the flow of information throughout an economy, and

to support the ability of firms to assimilate information through learning.

SURVEY OF POLICY MEASURES ON TRANSFER OF TACIT KNOWLEDGE IN EU MEMBER STATES

SURVEY OF POLICY MEASURES ON TRANSFER OF TACIT KNOWLEDGE IN EC MEMBER STATES

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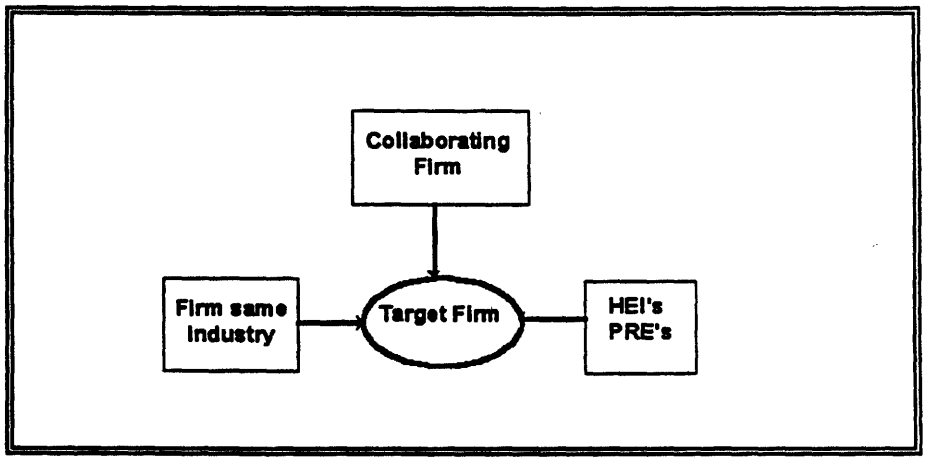
In this survey the definition of tacit knowledge relied very much on the German concept of 'Erfahrungswissen' or knowledge through experience. There are very few policy instruments which directly and explicitly addressed the definition strictly in those terms. To classify the material the survey team looked at it from an organisational perspective: what is transferred from whom to whom? In essence there are two dominant types of instruments which attempt to transfer "Erfahrungswissen". The first type is those that are transferring knowledge between higher education / research establishments and the target firm. This is by far the most common policy instrument. The second type concerned the inter-firm flows of tacit knowledge either through the collaboration of firms (co-makership, buyer supplier links etcetera) or between firms of the same industry. On this last type the survey did not find many examples mainly because it usually concerns direct competitors. Those cases which did were usually instruments for firms that had been under strong competition pressures and restructures in the past, for example in the textile industry.
Most of the policy instrument operate within the boundaries of the national state or the region. Hardly any instruments aim at links across the borders, for instance firms with institutes abroad and, with the exception of the Irish scheme, no multinational companies are involved.



The following tables give an overview of 22 different policy instruments found in the EU. They describe very succintelly the aim of the measure, the type of support provided and the results of the schemes. A more detailled descrition of schemes is provided in the extended forms which follow.

BELGIUM

COUNTRY BELGIUM

Name of Scheme: FIRST - ENTREPRISES

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Decree of 5 July regarding aid and interventions in the Walloon region for research and technologies (MB 17.10.90).		
In operation since: 1.10.1992	*Life of the Scheme:* No preset time limit	*Previous Schemes:*
Stated goals of the scheme: To encourage the transfer of knowledge and know how from academia to industry.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) The scheme is too young to have already undergone changes.		
Relation with other programmes: (is this scheme part of a programme or initiative) Relates to FIRST - University a scheme where a young university researcher works on a project that is of interest for an industrial company.		
Geographical coverage: (national, regional) Walloon region		
Entity responsible for the budget: Direction générale des technologies de la recherche et de l'énergie du Ministère de la Région Wallone. *Entity responsible for implementation:* "		

Name of Scheme: FIRST - ENTREPRISES

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)*

Firms

Specific requirements for participation in this scheme:

Firms ready to commit a research to a research project involving a transfer of knowledge from an academic research team. The researcher is to spend a significant part of his time in the academic lab. in order to acquaint himself with the knowledge and know how to be transferred.

Other selection criteria:

Differences in the amount of the subsidy according to the size of company (SME/LE), the maturity of the research (basic industrial research/applied research) and whether or not a new employee is recruited.
The foolwing research areas are aimed: electronics, mechatronics, mechanies, metrology, robotics, new materials, life sciences, fine chemistry, environmental technologies, informatics and energy

Name of Scheme: FIRST - ENTREPRISES

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** ***Part of the salary (50 + 80 %) of a researcher + 300000 BEF for the university lab. associated to the project.*** ***Maximum / minimum amounts per project or action and/ or reimbursement:*** Max. 3.800.000 BEF Min. 650.000 BEF
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) Subsidy
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Proposals are requested from companies jointly with academic research units.

Total cost over the lifetime of the scheme	*Expenditure per year*
n.a.	+ /- 80.000.000 BEF
Other budgetary information	

Name of Scheme: FIRST - ENTREPRISES

II. RESULTS

Number of organisations/people involved (please state which) *1988* *1989* *1990 n.a.* *1991*	*Observations*
Other measurements of results (per year) n.a.	
Bottlenecks n.a.	

III. EVALUATION OF RESULTS

Evaluator: *Brief summary of results of the evaluation:* n.a.

DENMARK

COUNTRY : DENMARK

Name of Scheme: THE SCHOLARSHIP SCHEME

I. DESCRIPTION OF SCHEME

I.a. General information

Type:		
Reference to legal basis: (white paper, act, public document) Part of coordinated support programme for entrepreneurs and small businesses under the Ministry of Industry, represented by the National Agency for Industry and Trade.		
In operation since: 1982	***Life of the Scheme:*** Still in operation	***Previous Schemes:***
Stated goals of the scheme: To promote the establishment of new Danish production companies with a high content of technology or know-how.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) No		
Relation with other programmes: (is this scheme part of a programme or initiative) It is an independent programme, but works closely together with the start-up scheme and the Grants Scheme for working up high-potential product ideas.		
Geographical coverage: National		
Entity responsible for the budget: DTI/Danish Innovation Centre ***Entity responsible for implementation:*** DTI/Danish Innovation Centre		

Name of Scheme: The Scholarship Scheme, Denmark

I.b. Target group

What is the target group: Private individuals with particulary promising product ideas who wish to start their own production business.
Specific requirements for participation in this scheme: *-Size (turnover, employees)* *-sectors, branches* *-technology* High technology or high level of know-how. *-age/investment stage* *-specific problems* *-geographical aspects* *-others*
Other selection criteria:
Other promoted activities: (examples: consultancy in definition of product, securing intellectual property rights, business plans, management training, etc.) Yes, comprising all the examples mentioned.

Name of Scheme The scholarship Scheme, Denmark

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** The scholarship covers subsistence for a maximum of 2 years, plus counselling from the scheme administration. In this period the scholar should document and establish the basis for setting up a new business. ***Maximum / minimum amounts per project or action and/ or reimbursement:*** Maximum support: 1 Mln DKK, minimum: 175.000 DKK
Type of support: Apart from the direct financial support to subsistence (the scholarship), up to 50.000 DKK is granted to cover expenses for external technical, commercial, legal or property right counselling.
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). In cooperation between the applicant and the secretariat the latter sets up an application to be presented before a grants committee under the National Agency for Industry and Trade. Through close contact and quarterly reports the secretariat monitors the scholar's development of the project.

Total cost over the lifetime of the scheme 25,5 mill. DKK	***Expenditure per year*** Budget 1993: 6 mill. DKK

Name of Scheme: Scholarschip scheme, Denmark

II. RESULTS

Number of firms involved	*Observations*
1988 7 *1989* 9 *1990* 6 *1991* 9	
Other measurements of results (per year) The total employment created, including subsuppliers, is 280 in 1991 (38 surviving companies out of 62). Average employment rate after 1-2 years: 5.3 after 7-8 years: 12.3	In average, 55% of the turnover in exporting scholarschip businesses comes from export.
Bottlenecks Additional equity capital financing.	

III. EVALUATION OF RESULTS

Evaluator:
Brief summary of results of the evaluation such as failure rate, economic effects, etc: No evaluation

COUNTRY DENMARK

Name of Scheme: THE SCOUT SCHEME

I. DESCRIPTION OF SCHEME

I.a. General information Looking up of product ideas in research centres

Type:		
Reference to legal basis: (white paper, act, public document) Act of business development		
In operation since: About 1980	***Life of the Scheme:*** ongoing	***Previous Schemes:***
Stated goals of the scheme: To promote development of product ideas emerging as spin off from research work.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) No		
Relation with other programmes: (is this scheme part of a programme or initiative) Part of entrepreneur including inventor programme		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: The National Agency of Trade and Industry ***Entity responsible for implementation:*** Danish Technology Institute		

Name of Scheme: The scout scheme, Denmark

I.b. Target group

What is the target group: Researchers and research centres
Specific requirements for participation in this scheme: *-Size (turnover, employees)* *-sectors, branches* *-technology* *-age/investment stage* *-specific problems* *-geographical aspects* *-others*
Other selection criteria:
Other promoted activities: (examples: consultancy in definition of product, securing intellectual property rights, business plans, management training, etc.) - examination of novelty - securing intellectual property rights - assistance to licencing negotiations

STB-TNO
May 1993

Survey of policy measures to transfer tacit knowledge between HEIs / PREs and Firms (1)

	Name Scheme	Aim/ objective	Type of support/ budget	Results
B	FIRST- Enterprise Walloon Region	Transfer of knowledge from HEIs to industry through secondment of researcher to academic lab.	Subsidy 50 to 80% of salary researcher.+ 7500 ECU for University. Exp. per year: 2,0 MECU	Started in 1992
D	Innovation Assistants (Bremen)	Knowledge transfer from HEIs to firms through employment of skilled personnel	Grants (40% of income). Max. 12000 ECU per person, 24000 ECU per firm. Exp. per year: 0,25 MECU	25 to 30 firms per year
Dk	Technology Scout Schemes	Identification of product ideas in HEIs and PREs to be licensed to industry	Interest free loan to scientists to patent and market product ideas. Repayable in case of success. Max. per loan 40000 ECU. Exp. 1992: 0,5 MECU	
E	PETRI	Transfer of public research to industry	grants for R&D in HEIs and PREs (50 to 70% of cost subsidised) Max. cost per project 80 to 120 thous.ECU. Exp. per year: 7.5 MECU	
	OTRI / OTT	Strengthening of Offices of transfer of Research results	Financial support of offices	
	Exchange of R&D personnel	Strengthening of R&D facilities in enterprises (SMEs) through scholarships to PhD/post doc. research in firms	Salary bonus to academics to do research in a firm. Salary bonus to R&D personnel which go to a HEI or PRE. Exp. per year: 1.2 MECU	

Survey of policy measures to transfer tacit knowledge between HEIs / PREs and Firms (2)

	Name Scheme	Aim / objective	Type of support / budget	Results
F	CIFRE	Transfer of knowledge through training. Firms can develop process or product, HEIs PREs gain experience in industrial research. Managed nationally through ANRT.	3 year grant for salary of researcher who must finish a thesis. 15000 ECU per researcher. Exp. per year: 29 MECU	600 new grants per year. (41% to contracts between SMEs and HEIs)
	CORTECH	Transfer of knowledge through training. Firms can develop process or product, HEIs PREs gain experience in industrial research. Managed regionally following different models.	1 year grant for salary of researcher. 1200 ECU per trainee. No diploma. Regional ins titutions cover part of cost of trainee and research institution.	Approx. 300 training grants per year
Irl	Techstart	Graduate placement in SMEs to improve products and processes (example ISO 9000)	Grants for cost of salary. 6250 ECU for a graduate 5600 ECU for a diploma holder + 2500 ECU in technical assistance Exp. per year: 0.8 MECU (1.5 MECU 1993)	140 to 190 placements per year
NL	KIM	Regional knowledge transfer from HEIs to SMEs through stimulating research and education directed to industry in HEIs	Grants (50%) of labour costs (Max. 14000 ECU), Advisory work (max. 7000 ECU), training (max. 2200 ECU)	40 projects
	TOP (Twente)	Stimulate graduates to set up knowledge intensive company through grants for part time job, training course, support in networking	Grant 14000 ECU (can be 2 or 3 per firm) 2000 ECU for research groups Exp. per year: 0,25 MECU	130 placements
UK	Teaching Company Scheme	Stimulate academic / business exchange and partnership through technology transfer and training	Grant of 15 to 70% of academic support and graduate employment cost. Plus advice from Teaching Company Directorate, regional consultants. Exp. 1992: 21 MECU government, 8,7 MECU Industry	460 programmes

Survey of policy measures to transfer tacit knowledge between Large Firms and SMEs (vertical)

	Name Scheme	Aim / objective	Type of support / budget	Results
D	Technology oriented information and visit programme (TOP)	transfer of know-how between larger, technologically leading firms and SMEs. Modelled on Inside UK Company Scheme.	Organisation of one day visits. Grants for organisation and logistics of contractor	1992: 500 visits to 30 firms
Irl	National linkage programme (NLP)	Develop trade links between Multinational companies located in Irl and potential suppliers	Support and advice on strategic planning operations, market skills, technical competence. Contacts between buyers and suppliers.	
UK	Inside the UK Company Scheme			

Survey of policy measures to transfer tacit knowledge between Firms (horizontal)

	Name Scheme	Aim / objective	Type of support / budget	Results
NL	PBTS-Demonstration Projects	Part of the PBTS technology promotion Programme which deals with demonstrations of advanced technologies	Grant of 37,5% of the project cost. Max. 225.000 ECU.	
D	Meetings of managers Textile industry	Exchange of experience on technological developments, quality and standards	Organisation of meetings of managers (2 to 4 times a year) No financial support from public administrations.	

SURVEY OF POLICY MEASURES ON TRANSFER OF TACIT KNOWLEDGE IN EC MEMBER STATES

M.S.	Name of the Scheme	Type of Scheme
B	FIRST- Enterprise	HEIs -> Firm
D	Technology oriented information and visit programme (TOP)	Large firms -> SMEs
	Innovation Assistants (Bremen)	HEIs -> Firms
	Meetings of managers Textile Industry	Firms -> Firms
Dk	Technology Scout Schemes	HEIs/PREs -> Firms
	Scholarship Scheme for Innovative Entrepreneurs	
	Business Start-up Scheme	
E	PETRI	HEIs/PREs -> Firms
	OTRI/OTT	HEIs -> Firms
	Exchange of R&D Personnel	HEIs/PREs <-> SMEs
	Concerted Projects	
F	CIFRE	HEIs/PREs -> Firms
	CORTECH	HEIs/PREs -> Firms
GR	No schemes available	
I	Training in ceramic sector	
IRL	National Linkage Programme (NLP)	(MNCs) ->SMEs
	Techstart	HEIs -> SMEs
L	No schemes available	
NL	PBTS- Demonstration Projects	Firms -> Firms
	Agents of knowledge transfer in SMEs (KIM)	HEIs -> SMEs
	TOP (Twente University)	HEIs -> SMEs
P	No schemes available	
UK	Company Teaching Scheme	HEIs -> Firms
	Inside UK Company Scheme	Large firms -> SMEs

Name of Scheme The scout scheme, Denmark

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** See: other promoted activities ***Maximum / minimum amounts per project or action and/ or reimbursement:*** No limitation
Type of support: Management and technical See: other promoted activities
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Consultants visit the research centres, searching for product ideas.

Total cost over the lifetime of the scheme 200.000 ECU pr. year	***Expenditure per year***
Other budgetary information	

Name of Scheme: The scout scheme, Denmark

II. RESULTS

Number of firms involved	*Observations*
1988 *1989* About 7% of the ideas *1990* are licenced to *1991* enterprises	
Other measurements of results (per year)	
Bottlenecks	

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation such as failure rate, economic effects, etc:

Not available.

COUNTRY DENMARK

Name of Scheme: Business Start-up Scheme

I. DESCRIPTION OF SCHEME

I.a. General information

Type:		
Reference to legal basis: (white paper, act, public document) Official budget of the Ministry of Industry. The start-up scheme forms part of the coordinated entrepreneur programme under the National Agency for Industry and Trade.		
In operation since: 1984	*Life of the Scheme:* In operation	*Previous Schemes:*
Stated goals of the scheme: It should be seen as a back-up to the entrepreneur's own efforts, adapted to the individual requirements and perspectives of each project, the perspectives being seen primarily in relation to the export potential of the prospects of import limitation. The overall idea behind the scheme is to create an incentive for entrepreneurs and small companies to make use of experienced external counsellors, either form the DIC or from other professional business advisors, since many young companies tend to invest an excessive amount of time and resources in overcoming standard start-up barriers.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) The scheme has moved towards a more flexible interpretation of the target group as regards number of employees in and age of the companies; and there is today a wider spread between minimum and maximum allocation of funds, all according tot the requirements of the individual companies.		
Relation with other programmes: (is this scheme part of a programme or initiative) Forms part of the coordinated entrepreneur programme and plays in this respect together with the Scholarship Scheme and a NAIT-scheme for working up high-potential product ideas in new SMEs.		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: DTI/Danish Innovation Centre (DIC) *Entity responsible for implementation:*		

Name of Scheme: **Business Start-up Scheme**

I.b. Target group

What is the target group: (for example, firms, organisations or individuals within firms and organisations)

See next item.

Specific requirements for participation in this scheme:

- persons who plan to start or take over a production company
- production companies which are less than 3 years old. Typically, these companies need external support in order to expand and thereby survive,
- established companies with no previous activities or experience within production, but with a wish to establish such, and therefore characterized as being in an entrepreneur-like situation. If the company is more than 3 years old, the staff limit is set to employees,
- service companies operating on a technology and/or know-how based concept. Same requirements to size and age as above.

Other selection criteria:

Name of Scheme: Business Start-up Scheme

I.c. Organization and Implementation

What is supported? ***See below*** ***Type of activities supported:*** ***Maximum / minimum amounts per project or action and/ or reimbursement:*** 1991-figures: Total expenditure: 8,9 mill. DKK, hereof: 100% funding: 5,8 mill. DKK, 75% funding: 3,0 mill. DKK. Number of projects: 100% funding: 593 (including 47 from 1990), 75% funding: 235 (including 44 from 1990). Average support per project: 100% funding: 10,600 DKK (= approx. 16 hours). 75% funding, approx: 20,000 DKK. Distribution DIC/external counselling: 100% funding: DIC: 95%, External: 5%. 75% funding:DIC: 32%, External: 68%.
Type of support: (describe the type of support. Example: grants, loans, advice, etc.)
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).

Total cost over the lifetime of the scheme	***Expenditure per year***
Other budgetary information	

Name of Scheme: Business Start-up Scheme

II. RESULTS

Number of organisations/people involved *(please state which)* *1988* *1989* *1990* *1991*	*Observations*
Other measurements of results (per year)	
Bottlenecks	

Name of Scheme: **Business Start-up Scheme**

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:

The support falls in two steps: a 100% funded evaluation and action planning phase, and a subsequent documentation and implementation phase in which the entrepreneur contributes with 25% of the costs. The key areas of the Start-up Services are: arrangement of contacts, market forecasts, market strategy, patenting issues, investment, financing, profitability, organisation and management capability, administrative systems, product evaluation, support schemes, and fiscal and legal matters.

GERMANY

COUNTRY GERMANY

Name of Scheme: INNOVATION - ASSISTENTS / BREMEN

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) act of adminstration		
In operation since: 1985	*Life of the Scheme:* unlimited	*Previous Schemes:* no
Stated goals of the scheme: support of firms to transfer innovative potential into new products/processes or to improve the planning process or the marketing of products - by means of transfer of knowledge from universities/polytechnics into business		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) yes. limitations of maximum turnover/number of employees have been reduced from 50 Mio. DM to 20 Mio. DM/resp. 100 persons; maximum number of assistents has been reduced to 2;		
Relation with other programmes: (is this scheme part of a programme or initiative) no relation with other programmes		
Geographical coverage: (national, regional): City of Bremen and Bremerhaven		
Entity responsible for the budget: Senator für Wirtschaft, Mittelstand und Technologie *Entity responsible for implementation:*		

Name of Scheme: **INNOVATION - ASSISTENTS /BREMEN**

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* SMEs, enterprises with less than 20 Mio. DM turnover and less than 100 employees; employment of academic personnel is necessary; new products/processes are expected to become profitable; employment contracts of 12 months at minimum
Specific requirements for participation in this scheme: no branches or large firms; no part-time jobs; no prolongation of jobs that have existed before; no employment of persons with more than 1 year employment in business since termination of university/polytechnics
Other selection criteria:

Name of Scheme: **INNOVATION - ASSISTENTS / BREMEN**

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** cost of personnel employment of skilled personnel ***Maximum / minimum amounts per project or action and/ or reimbursement:*** max. 24.000 DM per person, max. 48.000 DM per firm
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) grant; 40% of gross income, max. 24.000 DM per year per person
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Chambers of Commerce and Crafts, banks, and others inform entity responsible for implementation on demands; assistance is given to fill in the forms by the entity responible for implementation

Total cost over the lifetime of the scheme 1985-1992: 3.9 Mio. DM; on average 500.000 DM per year except the first year	***Expenditure per year***
Other budgetary information no other budgetary information	

Name of Scheme: INNOVATION - ASSISTENTS / BREMEN

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 38 firms/46 persons *1989* 28/31 *1990* 29/31 *1991* 24/26	easy scheme pressure of business
Other measurements of results (per year) no other measurements	
Bottlenecks no problems except financial situation of the state	

III. EVALUATION OF RESULTS

Evaluator: *Brief summary of results of the evaluation:* no information

COUNTRY GERMANY

Name of Scheme: MEETINGS OF MANAGERS IN TEXTILE INDUSTRY

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) no reference to legal basis		
In operation since: more than 40 years	*Life of the Scheme:* next 40 years	*Previous Schemes:* no
Stated goals of the scheme: Exchange experience. know-how. Define targets (technological, social). Set quality standards.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) learning process, adopted to technological or social changes		
Relation with other programmes: (is this scheme part of a programme or initiative) no		
Geographical coverage: (national, regional) Germany		
Entity responsible for the budget: Institut für Textil- und Verfahrenstechnik Körschtalstr. 26 D-7306 Denckendorf Tel 0711/3408-215 *Entity responsible for implementation:* Prof. Dr. G. Egbers		

Name of Scheme: MEETINGS OF MANAGERS IN TEXTILE INDUSTRY

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* plant managers, shift managers
Specific requirements for participation in this scheme: equivalent job
Other selection criteria: no

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** meetings twice a year ***Maximum / minimum amounts per project or action and/ or reimbursement:*** no max./min. amounts per projects
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) no information
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). meetings are organized either by the manufacturers association or by the institute

Total cost over the lifetime of the scheme no information on costs	***Expenditure per year***
Other budgetary information	

Name of Scheme: MEETINGS OF MANAGERS IN TEXTILE INDUSTRY

II. RESULTS

Number of organisations/people involved (please state which) *1988* *1989* *1990* *1991*	*Observations* different for the different organizations: spinner: two meetings per year at 4 regional places; attendance; about 30 people per meeting. weaver: two meetings per year at 5 places, attendance: 30 people per meeting knitters: two per year, 5 different groups, some at two places, some just one, attendance: 9-20 people.
Other measurements of results (per year)	
Bottlenecks	

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:

Has had big impact of intercompany technology transfer and jointly agreed standards

COUNTRY GERMANY

Name of Scheme: TECHNOLOGY - ORIENTED INFORMATION AND VISIT PROGRAMME (TOP)

I. Description of Scheme

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) act of administration		
In operation since: 1992	*Life of the Scheme:* 1992-1996	*Previous Schemes:* no
Stated goals of the scheme: transfer of technological know-how/tacit knowledge between big firms and SME to put them in the position for international competition		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) no change		
Relation with other programmes: (is this scheme part of a programme or initiative) TOP is a pilot project of the Federal Ministry of the Economy to promote transfer of technological knowledge. TOP is modelled after the "Inside UK company scheme"		
Geographical coverage: (national, regional) :Germany		
Entity responsible for the budget: Federal Ministry of the Economy *Entity responsible for implementation:* Federal Ministry of the Economy and as contractor: Institut für Medienentwicklung und Kommunikation, Frankfurt		

Name of Scheme: TECHNOLOGY - ORIENTED INFORMATION AND VISIT PROGRAMMA TOP

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Managers and technical personnel in innovation-oriented enterprises in trade and industry
Specific requirements for participation in this scheme: no specific requirements
Other selection criteria: no consultants, no lecturers, no students

Name of Scheme: TECHNOLOGY - ORIENTED INFORMATION AND VISIT PROGRAMME (TOP)

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** Organisation and logistics of the contractor ***Maximum / minimum amounts per project or action and/ or reimbursement:*** no max./min. amounts
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) grants
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). contractor organises 1-day-visits on important subjects in technologically leading firms, cataloque with dates is published annually, interesting SMEs get registered on demand; visitors get introduction, visit and discussion on specific technological subjects

Total cost over the lifetime of the scheme no information on costs	***Expenditure per year***
Other budgetary information	

Name of Scheme: TECHNOLOGY - ORIENTED INFORMATION AND VISIT PROGRAMME (TOP)

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 *1989* *1990* *1991* 1992 500 visitors, 30 visited firms	
Other measurements of results (per year) no other information	
Bottlenecks	

III. EVALUATION OF RESULTS

Evaluator:
Brief summary of results of the evaluation:
no information

SPAIN

COUNTRY SPAIN

Name of Scheme: CONCERTED PROJECTS

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Published in the Official Gazette		
In operation since: 1970	*Life of the Scheme:* 23 years	*Previous Schemes:*
Stated goals of the scheme: - Partial economic support from the Administration to R & D risky projects, of a precompetitive nature, submitted by companies. Particularly from small and medium size enterprises. - A public research group or more must participate in the project.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) Not much, except that the success of failure of each project is measured for the last 6-7 years on the basis of technical milestones throughout the project, rather than on economic selling impact parameters at the end of the project.		
Relation with other programmes: (is this scheme part of a programme or initiative) It is part of a general programme to stimulate the interaction between Public Research and Industry, set up by the National R & D Plan.		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: National R & D Plan *Entity responsible for implementation:* CDTI (Centro para el Desarrollo Technologico Industrial).		

Name of Scheme: CONCERTED PROJECTS

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* - Companies, particularly small and medium size enterprises. - Research groups of universities and public research institutions participating on the projects.
Specific requirements for participation in this scheme: - The R & D projects,-of a precompetitive nature, must be submitted by companies on a total cost basis. - One or various research groups from universities and public research institu tions must participate in each project.
Other selection criteria: - Quality of the proposal. - Possible economic impact of the final results. - Good financial situation of the company.

Name of Scheme: CONCERTED PROJECTS

I.c. Organization and Implementation

What is supported?
Type of activities supported:

R & D activities of risky projects, of a precompetitive nature, submitted by companies.

Maximum / minimum amounts per project or action and/ or reimbursement:

- No limit. On the average, however, the projects run for two years, with 500.000 - 1.000.000 US $ per year on a total cost basis.

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)

- The Administration provides at most 50% of the total cost of each project, in the form of a loan without interest, to be reimbursed after the project is finished in 4-5 annual payments.

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).
- The projects are submitted to CDTI, after being elaborated in close connection with CDTI.
- The projects are evaluated by an independent agency.
- The final selection is made by an experts panel.

Total cost over the lifetime of the scheme	*Expenditure per year*
Quite big	Approx. 90-100 millions US $

Other budgetary information

Payments made after each milestone is successfully achieved.

Name of Scheme: CONCERTED PROJECTS

II. RESULTS

Number of organisations/people involved (please state which) *1988* *1989* 200-300 companies/year *1990* 400-600 research groups/year *1991*	*Observations* The number of proposals always exceed the funds available by far.
Other measurements of results (per year)	
Bottlenecks None. If anything, only mention that the preparation and evaluation of the proposal are time-consuming. This is necessary in order to avoid too many failures.	

III. EVALUATION OF RESULTS

Evaluator:

Dr. Antonio CORTES

Brief summary of results of the evaluation:

By far, this is the scheme better known by the enterprises in Spain. Throughout the years the number of "failures" has been very small, so that most of the loaned money has been recovered.

A great number of these concerted projects went ahead into industrial production and commercialization.

COUNTRY SPAIN

Name of Scheme: OTRI/OTT NETWORK

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Public document. Budget approved by the Parliment.		
In operation since: 1988	*Life of the Scheme:* 5 years	*Previous Schemes:* None
Stated goals of the scheme: To create, or strenghten where existing, an OTRI (Office for the Transfer of Research Results) (similar to an ILO) in universities, public research institutions and non-profit R & D Associations.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) NO		
Relation with other programmes: (is this scheme part of a programme or initiative) It is part of a general programme to stimulate the interaction between Public Research and Industry, set up by the National R & D Plan.		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: National R & D Plan *Entity responsible for implementation:* Office for Technology Transfer of the National R & D Plan.		

Name of Scheme: OTRI/OTT NETWORK

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Universities, public research institutions and non-profit R & D associations.
Specific requirements for participation in this scheme: - To carry out R & D activities. - To be either an university, a public research institution or a non-profit R & D association.
Other selection criteria: - Capability of performing Research-Industry transfer activities.

Name of Scheme: OTRI/OTT NETWORK

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** Activities leading to the interaction between public research and industry. ***Maximum / minimum amounts per project or action and/ or reimbursement:*** Up to now each office has received a fixed amount per year to support all types of activities (protection of results, evaluation of results; licencing, technology days, etc.).
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) A fixed amount per year to each institution in the form of a grant. At present there are 40 universities, 12 public research institutions and 14 non-profit research associations integrated in the network.
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). A network has been sep up throughout Spain which is coordinated by the Office for Technology Transfer of the National R & D Plan.

Total cost over the lifetime of the scheme Approx. 13 millions US $	***Expenditure per year*** 2.6 millions US $
Other budgetary information The funds are given at the beginning of each year.	

Name of Scheme: OTRI/OTT NETWORK

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 40/100 *1989* 50/125 *1990* 60/150 *1991* 64/160	
Other measurements of results (per year) - Number of research contracts, which have increased considerably. - Number of patents filed in the uni versities. - Number of lisence agreements made.	
Bottlenecks - Some universities, research institutions and associations still question the usefulness of such liaison offices. Their own support is still limited.	

NOTE: For precise data on the cost of this scheme, the Office for Technology Transfer of the National R & D Plan, shoulds be contacted.

Name of Scheme: OTR/OTT NETWORK

III. EVALUATION OF RESULTS

Evaluator: Dr. Antonio CORTES

Brief summary of results of the evaluation:

I feel it has been a great success bringing together people from all the universities and most of the public research institutions and non-profit research associations, to exchange ideas and information and even work together for the transfer of research results to industry. However since the actors are numerous it is not always easy to find everybody to be equally efficient and enthusiatic.

COUNTRY SPAIN

Name of Scheme: EXCHANGE OF R&D PERSONNEL

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Published in the Official Gazette.		
In operation since: 1988	*Life of the Scheme:* 5 years	*Previous Schemes:* None
Stated goals of the scheme: A programme set up by the Administration to induce the formation of new R & D facilities in enterprises, or strengthen the existing ones. Particulary in small and medium size enterprises.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) NO		
Relation with other programmes: (is this scheme part of a programme or initiative) It is part of a general programme to stimulate the interaction between Public Research and Industry, set up by the National R & D Plan.		
Geographical coverage: (national, regional) : National		
Entity responsible for the budget: National R&D Plan *Entity responsible for implementation:* Dirección Genral de Investigación Científica y Técnica		

Name of Scheme: EXCHANGE OF R&D PERSONNEL

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Companies and firms. Particularly small and medium sized enterprises.
Specific requirements for participation in this scheme: - The company participating in this scheme should have R & D facilities, or is willing to open and establish such facilities. - The company must have some personnel of its own dedicated to R & D activities.
Other selection criteria: - Quality of the project to be carried out. - Quality of the candidates to be exchanged, based on their curricula.

Name of Scheme: EXCHANGE OF R&D PERSONNEL

I.c. Organization and Implementation

What is supported?
Type of activities supported:
Scholarships or salary bonus to Ph. D. and Postdoctoral students, and senior scientists.

Maximum / minimum amounts per project or action and/ or reimbursement:
- Each exchange limited to one year, except Ph. D. students up to four years.
- No limit up to now in the number of people to be exchanged.

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)
- Scholarships to Ph. D. and Postdoctotal student to be provided to a company.
- Salary bonus to University professors and research scientists to go to a company.
- Salary bonus to a company R&D person to go to a public research institution.

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).
- Students to make the Ph. D experimental thesis in a company. Up to four years.
- Postdoctoral students to work for one year with a company.
- University professors and research scientists to worl for a year with a company.
- R&D persons from a company to work for one year at a public research institu tion.

Total cost over the lifetime of the scheme	*Expenditure per year*
Approx. 7.5 millions US $	1.5 millions US $

Other budgetary information

The budget is still open to be increased.

Name of Scheme: EXCHANGE OF R&D PERSONNEL

II. RESULTS

Number of organisations/people involved (please state which) Appoximately: *1988* 80-100/50 *1989* 80-100/50 *1990* 80-100/50 *1991* 80-100/50	*Observations* Most of the Postdoctoral students in exchange have been hired by the companies.
Other measurements of results (per year)	
Bottlenecks - Still not well known by companies, particularly small and medium size enterprises, dispite the massive diffusion of the scheme. - Risk of Ph. students spending too much time in the university departments they are associated with.	

Name of Scheme: EXCHANGE OF R&D PERSONNEL

III. EVALUATION OF RESULTS

Evaluator: Dr. Antonio Cortes

Brief summary of results of the evaluation:

I consider this scheme very useful, particularly for small and medium size enterprises which can not afford having enough R&D personnel - for medium or long range projects. A great majority of the companies have shown their satisfaction with this scheme. In most cases the Postdoctoral studients have been hired by the companies after the one year exchange.

COUNTRY SPAIN

Name of Scheme: P.E.T.R.I.

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Published in the Official Gazette.		
In operation since: 1989	*Life of the Scheme:* 4 years	*Previous Schemes:* none
Stated goals of the scheme: It is a programme set up by the Administration to stimulate the transfer of research results from public research to industry.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) NO		
Relation with other programmes: (is this scheme part of a programme or initiative) It is part of a general programme to stimulate the interaction between Public Research and Industry, set up by the National R & D Plan.		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: National R & D Plan *Entity responsible for implementation:* Office for Technology Transfer of the National R & D Plan.		

Name of Scheme: P.E.T.R.I.

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Research groups in universities and public research institutions. The companies participate in the financial cost of the projects and, occasionally, in the work to be done.
Specific requirements for participation in this scheme: - The research team should have research results of potenial use that needs to be completed (scale-up, prototype, etc.). - A company should be interested in developing and selling the results, and therefore in co-financing the project.
Other selection criteria: - Quality of the research teams. - Quality and economic interest of the proposals.

Name of Scheme: P.E.T.R.I.

I.c. Organization and Implementation

What is supported?
Type of activities supported:

Research and development work carried out by research groups in universities and public research institutions, on a marginal cost basis.

Maximum / minimum amounts per project or action and/ or reimbursement:
No maximum. On the average, however, a PETRI project runs for 1 to 2 years, with about 100.000 to 150.000 US $ per year.

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)
The National R & D Plan provides 50 to 70 % of the cost of each project.
The rest is provided by the company willing to exploit the final results. In some cases, the National R & D Plan provides 100 % of the cost.

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).
- Public research groups send proposals, in which the participation and co-financing of a company is included.
- The proposals are evaluated for their technical quality and economic interest by an independent agency.
- The final selection is made by an experts panel.

Total cost over the lifetime of the scheme	*Expenditure per year*
Approx. 35 millions US $	9 millions US $

Other budgetary information
All the funds are provided at the beginning of the projects.

Name of Scheme: P.E.T.R.I.

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 30-40/unknown (plenty) *1989* 30-40/ " " *1990* 39-40/ " " *1991*	*A final report is requested from the research group and the participating company, to find out if real transfer did finally take place.*
Other measurements of results (per year)	
Bottlenecks It is not always easy to find a company willing to participate, particulary when the results, to be completed, although attractive, are very far from market.	

III. EVALUATION OF RESULTS

Evaluator: Dr. Antonia CORTES

Brief summary of results of the evaluation:

In the personal opinion of Mr. Cortes, director of the Office for Technology Transfer for more than two years and responsible for the management of this scheme, the companies participating in the scheme showed full satisfaction.
More than 50 % of the PETRI projects went ahead towards the real transfer and commercialization of a product, process or technical know-how.

FRANCE

COUNTRY FRANCE

Name of Scheme: CIFRE

I. DESCRIPTION OF SCHEME

I.a. General information

Type:		
Reference to legal basis: (white paper, act, public document) Decision taken by the Ministry of Research in 1981.		
In operation since: 1981	*Life of the Scheme:*	*Previous Schemes:*
Stated goals of the scheme: To bring together three partners (enterprises, laboratory and graduate student) to develope an industrial project. One of the component of the project is the realisation of a research . One of the output of the research is the a thesis or PhD.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) - increasing number of grants from 50 in 1981 to 500 in 1993. - a large number of scientific fields. 10% of applications in Social Science in 1993.		
Relation with other programmes: (is this scheme part of a programme or initiative) That's a part of two programs: - support training by research - support the innovation process inside the firm.		
Geographical coverage: (national, regional) National		
Entity responsible for the budget: Ministerie de l'Enseignement supérieur et de la Recherche (MESR) *Entity responsible for implementation:* Association Nationale de la Recherche technique (ANRT)		

Name of Scheme: CIFRE

I.b. Target group

What is the target group: (for example, firms, organisations or individuals within firms and organisations)

- enterprises
- research laboratories which ensure the training by research and the scientific direction of the PhD student
- graduate student (engineers or DEA*) who would like to develope a PhD in an enterprise

Specific requirements for participation in this scheme:

- The convention supposes that the enterprise employs the graduate student who wants to make a PhD
- Three different actors have to participate:
a. the enterprise is a french firm (French law)
b. the research laboratory must be good enough to ensure the scientific direction of the PhD
c. A French student of around 26 years, who wants to make a PhD and to work for a private company after his PhD.
Selection by the research laboratory and the enterprise.

Other selection criteria:

* DEA means Diplomes d'Études Approfondies. You have to do it before beginning a PhD. It's the 5th year of University. The equivalent is a master degree.

Name of Scheme: CIFRE

I.c. Organization and Implementation

What is supported?
Type of activities supported:

Research and Innovation: works done by a student who likes to prepare a PhD.

Maximum / minimum amounts per project or action and/ or reimbursement:

Fixed amount about 92700 FF/year in 1993 for 3 years maximum.

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)

Grant given to the enterprise for the employment of the graduate student who prepares a PhD.

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).

ANRT is in charge of the management of the initiative.
ANRT receives all the applications, prepares all the forms, makes the selection, and gives an answer within 2 months time.

Total cost over the lifetime of the scheme	*Expenditure per year*
1981 - 1993 1300 MF	190 MF in 1993 as state report MF = 10^6 francs
Other budgetary information	

Name of Scheme: CIFRE

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 498 *1989* 533 *1990* 569 *1991* 572	That's the number of CIFRE grant given each year.
Other measurements of results (per year) The target is about 600 grants/year in 1993.	
Bottlenecks	

Name of Scheme: CIFRE

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:

See the document presented by Temple and Le Duc.

IRELAND

COUNTRY IRELAND

Name of Scheme: National Linkage Programme (N.L.P.)

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) The NLP was announced in the Government white paper on Industrial Policy in 1984.		
In operation since: July 1985	*Life of the Scheme:* it continues	*Previous Schemes:* 'can you make it' exhibitions etc.
Stated goals of the scheme: To maximise the amount of raw materials components and services sourced locally by manufacturing industry. In particular it aims to develop trade links between multi national companies who have established in Ireland and Irish based companies who could act as suppliers.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) Goals have not been changed but there is now a stronger sectoral focus.		
Relation with other programmes: (is this scheme part of a programme or initiative) It is complimentary to programmes aimed at encouraging and assisting industry (including small firms) to successfully develop.		
Geographical coverage: (national, regional): National		
Entity responsible for the budget: Government source of funding *Entity responsible for implementation:* Industrial Development Authority (IDA)		

Name of Scheme: National Linkage Programme (NLP)

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)*

Purchasing companies - multinationals and others involving purchasing
and
Supplier companies - small medium and some large including owners and sales/marketing staff.

Specific requirements for participation in this scheme:

Purchasing companies who are willing to consider sourcing from internationally competitive local suppliers and Supplier Companies who are keen to meet the requirements of the purchaser in relation to quality service and price while in some cases making changes to meet these needs.

Other selection criteria:

In relation to suppliers they must be enthusiastic and committed in relation to growing their business and should be financially sound.
In relation to MNC purchasing companies those with an active vendor development policy are commercially and strategically important for suppliers SMEs and for the programme success.

Name of Scheme: National Linkage Programme (NLP)

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** Advice guidance and encouragement is provided Strategic Planning operations, market skills, technical competence, enhancement. ***Maximum / minimum amounts per project or action and/ or reimbursement:*** N/A
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) Establish vendor development policy of MNC purchasers. We obtain the necessary ingredients required to become a successful supplier from the purchasing firms and details of their specific purchases. This information is then used to help supplier companies to tune into opportunities.
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Meet CEOS of purchasing companies and obtain their goodwill to work with purchasing related personnel and obtain detailed funding information which is used to guide, help suppliers as already outlined.

Total cost over the lifetime of the scheme Not available due to multi agency involvement	***Expenditure per year*** Not available due to multi agency involvement
Other budgetary information	

Name of Scheme: National Linkage Programme (NLP)

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
people organisations *1988* 16 6 *1989* 12 6 *1990* 12 5 *1991* 14 4	While the IDA is the organisation responsible for NLP, other organisations contribute staff and expertise e.g. EOLAS, FAS
Other measurements of results (per year)	Up to the end of 1992 the work of the NLP helped over £300 million in new business to transfer to the Irish economy.
Bottlenecks Bridging gaps in the supplier infrastructure	

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:
The NLP has helped:
* Irish supplier companies to realise their potential to become profitable suppliers to Irish and overseas markets to world class standards.
* Purchasing companies (mainly larger manufacturing industries) to improve their own performances in internationally competitive markets.
* To improve the industrial infrastructure thereby encouraging further investment in Ireland.

COUNTRY **IRELAND**

Name of Scheme: TECHSTART

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) EOLAS initiative		
In operation since: 1989	***Life of the Scheme:*** on going	***Previous Schemes:*** STEP
Stated goals of the scheme: To aid industrial development through enhancement of the Technological capability or Irish firms - effective use of technology to lift business performance.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) NO		
Relation with other programmes: (is this scheme part of a programme or initiative) Techstart is part of a number of EOLAS Programmes to aid small industry i.e. TMP, Manufacturing Audits, Technology Transfer Programme.		
Geographical coverage: (national, regional): National		
Entity responsible for the budget: EOLAS ***Entity responsible for implementation:*** EOLAS		

Name of Scheme: **TECHSTART**

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Small manufacturing companies or internationally traded service companies with limited Technological Expertise.
Specific requirements for participation in this scheme: Company must have agreed a specific technical/quality goal that requires the assistance of a Techstart graduate.
Other selection criteria: Small number of technical graduates employed by company.

Name of Scheme: TECHSTART

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** Companies aiming to improve their products and processes i.e. implement a quality standard ISO 9000. ***Maximum / minimum amounts per project or action and/ or reimbursement:*** £ 5,000 Salary subsidy for a graduate £ 4,500 Salary subsidy for a Diploma Holder
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) A further £ 2,000 is available to assist the graduate to buy in technical expertise form EOLAS, 3rd Level Institutions or approved consultants.
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Techstart is run with a core team at Head Office (3) and using the EOLAS Regional Offices and the Technology Transfer Executives.

Total cost over the lifetime of the scheme	*Expenditure per year*
1989 - 1992 £ 2,542,00	Average 89-92 £ 635,625 Expenditure 1992 £ 1,117,629
Other budgetary information The Regional Officers and the Technology Transfer Executives are not charged to the Techstart budget.	

Name of Scheme: TECHSTART

II. RESULTS

Number of organisations/people involved (please state which) Placements ***1988*** - ***1989*** 46 ***1990*** 147 ***1991*** 185 ***1992*** 194	***Observations*** Number of Techstart graduates placed in a particular year.
Other measurements of results (per year) Number of Techstart graduates retained at end of a 1 year contract 74% plus.	Number of projects successfully completed.
Bottlenecks	

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:
Review of Techstart - Industrial Impact
* Companies investment in programme far exceeded grant aid.
* Direct Benefits: enhanced technology 80% of companies.
* Increased sales 43% of companies.
* Development of new improved products 39% of companies.
* New systems 69% of companies.
* Cost reduction 33% of companies.
* Employment Impact: retention by companies of the placement over 73%.
* Additional/Spin off jobs - 2 jobs

ITALY

COUNTRY ITALY

Name of Scheme: Survey Pattern of local professional and training needs in ceramic sector

I. DESCRIPTION OF SCHEME

I.a. General information

Type:		
Reference to legal basis: (white paper, act, public document) Public document of ministry of labour: department locational training		
In operation since: November 1990	*Life of the Scheme:* 15.09.92/15.10.92	*Previous Schemes:* Observatory on professions
Stated goals of the scheme: Analysis of qualified workers demand and training needs in small and medium firms. Supply and demand of specialized or semiskilled workers considering the peculiarity of local labourmarket.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process)		
Relation with other programmes: (is this scheme part of a programme or initiative) Survey of local professional and training needs: the Italian mechanical industry.		
Geographical coverage: (national, regional) Local level (Emilia Romagna)		
Entity responsible for the budget: Isfol-local authority of Ravenna *Entity responsible for implementation:* Isfol		

Name of Scheme: Survey Pattern of local professional and training needs in ceramic sector

I.b. Target group Small, Medium firms and handicraft sector

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* A sample of firms and individuals within firms.
Specific requirements for participation in this scheme:
Other selection criteria: Firms with more than three employees

Name of Scheme: Survey Pattern of local professional and training needs in ceramic sector

I.c. Organization and Implementation Isfol - local authority of Ravenna

What is supported? *Type of activities supported:* *Costs, research/action, report* *Maximum / minimum amounts per project or action and/ or reimbursement:*
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) Advices, the exchange and the transfer of information cooperation among different public and private structures (firms, trade unions, local authorities).
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). First step: interviews to employers organizations, trainers on the critical areas of this productive sector. Second step: collection of information with questionnaire about supply and demand of qualified workers.

Total cost over the lifetime of the scheme	*Expenditure per year*
Other budgetary information	

Name of Scheme: Survey Pattern of local professional and training needs in ceramic sector

II. RESULTS

Number of organisations/people involved (please state which) *1988* *1989* *1990* *1991*	*Observations* 1990: Elaboration of the Survey 1991: Arrangement of agreement among different parties 1992: Research and formulation of results
Other measurements of results (per year)	1993: National workshop of evaluation. Measures in course of elaboration to extend this kind of survey on local market, to other firms.

Bottlenecks

In the small medium firms, every worker has to have competences on all production phases (businesstrade, quality control, maintenance staff). They are, at the same time ceramist, decorator, trainer etc.. It is necessary to foster qualified workers, as owner and employees to support the efficiency of production.
Training on the job, learning by doing are the keys of success in the future.

Name of Scheme: Survey Pattern of local professional and training needs in ceramic sector

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation:

In the future it will be necessary to identify organizational characteristics to use in the configuration of different professional profiles and in the design of training.
The survey focus two critical areas: the first is linked with the need to improve entrepreneurial competences not only for employers but also for employees.
The second one is connected with the needs of training in this field.
These firms represent 80% of the industrial sector.

NETHERLANDS

COUNTRY NETHERLANDS

Name of Scheme: Business Oriented Technology Promotion Programme (PBTS)

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) PBTS Regeling (start 1988, nr. 42, start 1991, nr. 49)		
In operation since: 1987	*Life of the Scheme:* not restricted	*Previous Schemes:* -
Stated goals of the scheme: Stimulate firms to do research and development in certain areas of technology Every year the specific areas are reconsidered for which subsidies will be available.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) No important changes		
Relation with other programmes: (is this scheme part of a programme or initiative) PBTS is an instrument in the National Technology Programs. PBTS, aimed at enterprises, together with Innovation Oriented Research Programmes (IOP's) for universities, are designed to stimulate knowledge development and Technological development loans (TOK) on the other side, for development of products and processes.		
Geographical coverage: national		
Entity responsible for the budget: Ministry for Economic Affairs *Entity responsible for implementation:* SENTER		

Name of Scheme: Technology Promotion Programme (PBTS), Netherlands

I.b. Target group

What is the target group: Dutch enterprises
Specific requirements for participation in this scheme: R&D in the following areas: * biotechnology, information-technology, new materials technology, environmental technology.
Other selection criteria: research projects feasibility projects demonstration projects

Name of Scheme Technology Promotion Programme (PBTS), Netherlands

I.c. Organization and Implementation

What is supported?
Type of activities supported: Research-projects, Feasibility-studies
Demonstration-projects (not for biotechnology)

Maximum / minimum amounts per project or action and/ or reimbursement:
subsidy up to 37,5% of project-costs, to a maximum of
-for feasibility-studies Dfl. 250.000 (or 500.00 for concerted projects)
-research projects 20% of research-budget
-demonstration-projects Dfl. 500.000 (or 1.000.000 for concerted actions)

Type of support:

Subsidy, direct to the firm or consortium undertaking the project.
Financial support is 37,5% of project costs, such as salaries of direct personnel, material costs, investment costs, patents costs, travel costs and out of pocket costs for third parties, included an additional amount of 40% of the personnel costs for indirect activities.

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).

Yearly fixed budgets per technology theme
Programme is published yearly
Senter acts as executor
Advisory Board judges project quality and degree of innovation

Total cost over the lifetime of the scheme	*Expenditure per year*
ƒ 740 million (starting 1987-1992)	> ƒ 100 million
Other budgetary information	

Name of Scheme: Technology Promotion Programme (PBTS), Netherlands

II. RESULTS

Number of organisations/people involved			*Observations*
1987	requests	495	
1988	800	964	
1989	600	655	
1990	600	708	
1991	750	904	
Other measurements of results (per year)			
Bottlenecks For small enterprises: the formulation of a good project plan.			

III. EVALUATION OF RESULTS

Evaluator:

Brief summary of results of the evaluation such as failure rate, economic effects, etc:

n.a.

COUNTRY NETHERLANDS

Name of Scheme: KIM (Kennisdragers in MKB)

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document)		
In operation since: 1990	*Life of the Scheme:* 2 (demo-project)	*Previous Schemes:*
Stated goals of the scheme: KIM-concept: - to stimulate knowledge transfer between education + SMEs (with a view to an increase of the quality + competitiveness of the SMEs) by bringing in an higher educated technician. - to stimulate research and education directed to industry at the educational in M. demo-project: 40 innovation projects in SME's within 2 years		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) KIM-concept: more emphasis on innovation in SMEs; lesser emphasis on the role of education (all institutions) in this proces. demo-project: 40 projects in 3 years		
Relation with other programmes: (is this scheme part of a programme or initiative) This scheme can be seen as one of the "tacit transfer methods" besides: - innovation Centre Network, branche technology centres and technology centres		
Geographical coverage: (national, regional) regional (the demo project is directed to 2 regions)		
Entity responsible for the budget: (external) programma management *Entity responsible for implementation:* Innovation Centres		

Name of Scheme: KIM

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* 1. SMEs 2. higher educated technicians (higher vocational and university level) 3. educational institutions (for the advice role)
Specific requirements for participation in this scheme: 1. SMEs - interest in innovation - less than 5% of the labour force has a higher educational level - a well formulated innovation project (goal, timeschedule, costs etc.) 2. higher educated: - prepared to work in SME - interest in innovation 3. ed. institutions - will to establish relations with SMEs.
Other selection criteria:

Name of Scheme: KIM

I.c. Organization and Implementation

What is supported?
Type of activities supported:
- labour costs
- costs of professional advice/counselling
- costs for extra training of the higher technician (symposia, workshops etc.)

Maximum / mini-mum amounts per project or action and/ or reimbursement:
- labour costs : 50% (= f 30.000,-- a year)) max. f 50.000,-- for 1
- advice : " (= f 15.000,-- a year)) higher educated for 1 year
- training : " (= f 5.000,-- a year))

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).
- Innovation Centres in their daily contact with their clients make an anylysis of the possibility for the "KIM-approach" in a specific situation in a specific SME.
- Innovation Centre + SME formulate an innovation project and send it in to the programme management.
- the programme management decides to take up the project in the KIM-programme and makes the contracts and the "matching" of the higher educated + the SME.

Total cost over the lifetime of the scheme	*Expenditure per year*
f 2.500.000,--	

Other budgetary information
- 40 KIM-projects x f 50.000,-- = f 3.000.000,--
- programme management (incl. PR, selection etc) = f 500.000,--

Name of Scheme: KIM

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 *1989* *1990* *1991* 12 KIM-projects 1993 37 KIM-projects	the demo-project had a slow start (communication and start problems between external programme management + Innovation Centre and finding enough SMEs and innovation projects needs time)
Other measurements of results (per year)	
Bottlenecks - finding the right SMEs - finding enough higher educated technicians - "matching" these two "components" in one innovation project (sometimes a difficult job!)	

Name of Scheme: KIM

III. EVALUATION OF RESULTS

Evaluator:

- Programme management
- external research/advice agency

Brief summary of results of the evaluation:

* KIM brings a SME to innovation:
  - "in only 20% of the cases there will be an innovation project without KIM"
  - "in 10% of the cases there is a continuation of the innovation project after the KIM-year"
* KIM is a possibility for the SME + higher educated to learn to known each other:
  - "80% of the higher educated get a permanent appointment afther the KIM-year"
* effective implementation of the KIM-concept requires the help of an intermediary (like the innovation centres):
  - innovation in a SME means to convince the entrepreneur, to help him to articulate and formulate his problems, to guide a project
* the KIM-concept is not the way to bring together SMEs and education:
  - "only 20% of the SMEs got a better relationship with education by KIM, while 50% wish a better relationship

The demo-project ended with 37 innovation projects. The Ministry of Economic Affairs has the intention to continu the demo-project on a national scale (start is expected in 1994).

COUNTRY NETHERLANDS

Name of Scheme: TOP

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document)		
In operation since: 1984	*Life of the Scheme:* still in operation	*Previous Schemes:* no
Stated goals of the scheme: * Stimulate graduates of the University of Twente (UT) to set up their own knowledge-intensive enterprise, using different incentives * (Operational) start up 15 enterprises per year.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) Not essentially. Minor changes/developments have been 1) graduates from other HEI's were accepted as well; 2) temporary placement with research group (originally 50%) became variable (between 50% and 10%) 3) partial repayment of seed money.		
Relation with other programmes: (is this scheme part of a programme or initiative) The scheme was developed as ar instrument of the "Transferpunt" of the UT. Amis of the Transferpunt were a) to stimulate cooperation between UT and SMEs and b) to transfer information about new technologies to SMEs.		
Geographical coverage: (national, regional) national		
Entity responsible for the budget: TRD/Univeristy of Twente *Entity responsible for implementation:* TRD/University of Twente		

Name of Scheme: TOP

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Graduates of HEI's, with special emphasis on UT.
Specific requirements for participation in this scheme: Applier 1) must have graduated at a HEI. 2) must make a business plan, to be accepted by a steering committee. 3) is suggested to follow a course on "How to become an entrepreneur". Progress of participant to be evaluated by the steering committee after ½ year.
Other selection criteria:

Name of Scheme: TOP

I.c. Organization and Implementation

What is supported?
Type of activities supported:
Applicants are supported (by means of a part-time job with a "matching" research group) in their aspiration to set up their own company. Other supporting instruments are :
a) course "how to become an entrepreneur";
b) appointment of mentor;
c) networking with potential clients.
Maximum / minimum amounts per project or action and/ or reimbursement:
Dfl. 30.000,-- per participant (sometimes 2-3 participants per company).
Dfl. 5.000,-- per participant for research group.
50% to be repaid, interest-free in five years.

Type of support: (describe the type of support. Example: grants, loans, advice, etc.)
a) appointment of mentor
b) loan/grant/seed money
c) course "how to become an entrepreneur"
d) networking for jobs/clients
e) basic office facilities
f) support by experts in research group
g) Business and Technology Group Twente (club).

Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group).
Actors are:
1) Projectmanagement with Transferpunt/TRD
2) Steering committee
3) Research groups
4) Mentors
5) Centre of Innovative Entrepreneurship (CIOT)

Total cost over the lifetime of the scheme	*Expenditure per year*
± 4.7 million DFL.	± 525.000 DFL.

Other budgetary information 1) initially funded by Ministry of Economic Affairs 2) later additional funds by ESF.

Name of Scheme: TOP

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1988 *1989* 130 places awarded leading to *1990* 94 new firms *1991* 1992	16 firms (17%) have stopped their activiteis. Of the remaining 78 firms, 40 are performing very well, 17 are performing reasonably well, and 21 are too new to judge.
Other measurements of results (per year)	
Bottlenecks	

III. EVALUATION OF RESULTS

Evaluator: *Brief summary of results of the evaluation:* n.a.

UNITED KINGDOM

COUNTRY UNITED KINGDOM

Name of Scheme: Teaching Company Scheme

I. DESCRIPTION OF SCHEME

I.a. General information

Type: (do not fill in)		
Reference to legal basis: (white paper, act, public document) Within the remits of the six sponsoring government agencies		
In operation since: 1975	***Life of the Scheme:*** open ended	***Previous Schemes:*** -
Stated goals of the scheme: To strengthen the competitiveness and wealth creation of the UK by the stimulation of innovation in industry through partnerships between academia and business. To facilitate the transfer of technology and the spread of technical and management skills, and to encourage industrial investment in training, research and development. To provide industry based training, supervised jointly by academic and industrial staff, for young graduates intending to pursue careers in industry. To enhance the levels of academic research and training relevant to business by stimulating collaborative research and development projects and forging lasting partnerships between academia and business.		
Have the goals been changed during the implementation of the scheme: (describe changes through evaluation and learning process) Goals largely unchanged but industry sector and academic disciplinary remit has gradually widened.		
Relation with other programmes: (is this scheme part of a programme or initiative) Forms part of the technology transfer and education and training remits of the sponsoring agencies.		
Geographical coverage: (national, regional) UK		

Entity responsible for the budget:
The six sponsoring agencies are: Science and Engineering Research Council, Department of Trade and Industry, Economic and Social Research Council, Department of Economic Development (Northern Ireland), Ministry of Agriculture, Fisheries and Food Department of the Environment
Entity responsible for implementation:
Teaching Company Directorate, Part of Cranfield Institute of Technology

Name of Scheme: **Teaching Company Scheme**

I.b. Target group

What is the target group: *(for example, firms, organisations or individuals within firms and organisations)* Industry and Commerce - Firms of all sizes Universities and equivalent higher education institutions Young graduates
Specific requirements for participation in this scheme: COMPANIES must be financially viable and need university expertise to achieve strategic goals which will improve their competitiveness. UNIVERSITY GROUPS must have the expertise the companies need and be prepared to make the relevant staff and facilities available. GRADUATES must have relevant qualifications, normally under 28 with at least second class degree and have the personal qualities to bring about change in industry.
Other selection criteria: Priority topics/sectors agreed with sponsors Eg: advanced IT (SERC/DIT) food processing (MAFF)

Name of Scheme: Teaching Company Scheme

I.c. Organization and Implementation

What is supported? ***Type of activities supported:*** Technology transfer Graduate training (in companies) ***Maximum / minimum amounts per project or action and/ or reimbursement:*** 15-70% of academic support and graduate employment costs (depending on size of company and whether a repeat programme)
Type of support: (describe the type of support. Example: grants, loans, advice, etc.) Grant to university to provide academic support and graduate employment. Advice/support from Teaching Company Directorate's regional consultants.
Organization and structure: (describe briefly how the scheme works, the actors involved, how they reach the target group). Each TCS programme is a partnership between 1 company and 1 university group employing 1 or more graduates. The graduates work on jointly supervised development projects within the company and receive additional professional training.

Total cost over the lifetime of the scheme	*Expenditure per year*
not known	1992: £ 17M (Government) £ 7M (Industry - direct)
Other budgetary information	

Name of Scheme: Teaching Company Scheme

II. RESULTS

Number of organisations/people involved (please state which)	*Observations*
1990 *1991* 350 *1992* 393 *1993* 460	
Other measurements of results (per year)	

Bottlenecks

The size of the scheme is limited by the availability of government funds. Without funding constraint a growth of at least 15% P.A. could be achieved.

III. EVALUATION OF RESULTS

Evaluator: Panel of experts plus KPMG consultants, Institute of Manpower Studies and DTI assessment unit (the 'Fender Report', 1991)

Brief summary of results of the evaluation:

1. The mission is being achieved.
2. 75% of industrial participants and 67% of academic participants rated the scheme 'very highly'.
   80% of graduates offered a permanent job. Former teaching company associates (graduates) achieve a salary 28% higher than comparable graduates in industry.
3. The scheme should continue and diversify into other disciplines and industry sectors.

ANNEX

PUBLIC MEASURES TO PROMOTE THE ACQUISITION AND DIFFUSION OF TACIT KNOWLEDGE

SPRINT/EIMS POLICY EXCHANGE WORKSHOP N° 2

Venue : Bâtiment Jean Monnet, Luxembourg
25-26 May 1993
Room M5

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25 MAY

Chairman :

09H30	**Welcome and Introduction**	R. MIEGE (DG XIII)
	SESSION I - Perspectives on Tacit Knowledge	
09H35	(1) The Nature and Relevance of Tacit Knowledge for Innovative Firms	T. DURAND (F) (Centrale Management)
	(2) The Importance of Tacit Knowledge Flows to Industrial and Technological Competitive Advantage: A Macro View	R. CHABBAL (F) (MRT)
10H30	*Coffee-break*	
	SESSION II - Policy perspectives	
10H45	(3) The role of policy in supporting the acquisition. diffusion and protection of tacit knowledge	L. SOETE (NL) (MERIT)
	(4) Public support of the Acquisition and Diffusion of Tacit Knowledge: The main approaches by Member States	G. FAHRENKROG (NL) (TNO)
	(5) Comments	

12H30	*Lunch*	
	Chairman :	
14H00	**SESSION III - Support of Tacit Knowledge Transfer by Stimulating Mobility**	
	(6) Secondments from University to Industry: The UK Teaching Company Scheme	J. MONNIOT (UK) (Teaching Company Directorate)
	(7) The Placement of Industrial Researchers and Engineers in Universities and Research centers Experiences from Germany	
	(8) The Placement of Technicians in France: The Cortech and Ciffre Schemes	J.M. LEDUC (F) (MRT)
	(9) Comments	A. CORTES (E) (CSIC)
15H45	*Coffee-break*	
16H00	**SESSION IV - Support of Tacit Knowledge Transfer by Site Demonstrations**	
	(10) Business Oriented Technology Promotion Programme (PBTS) in Netherlands	VAN DER TORREN (NL) (Senter)
	(11) Site Visits of the German Textile Research Association	
	(12) Comments	
17H30	Close	
18H30	*Dinner*	
	Invited speaker :	S. TATSUNO (US) (Neoconcepts)
21H00	Bus back to hotels	

26 MAY

Chairman :

09H30	**SESSION V -** **Issues of Strategic Orientation, Design, Management and Evaluation of Support schemes: Problems and Perspectives**	
	(13) What is the Role of Clubs in Sharing Tacit Knowledge? How Can that be Supported by Public Policy?	R. LIWICKI (UK) (Science and Engineering Research Council)
	Introduction	
	(14) How to Stimulate the Transfer of Know-how in User-Supplier Relationships ?	M. WHITE (IRL) (Eolas)
	Introduction	
	(15) Why and How to Evaluate Schemes?	P. TEMPLE (F)
	Introduction	(Cortech)
10H30	*Coffee-break*	
10H45	**SESSION VI - Community Actions and Support Schemes**	
	(16) COMETT	D. GUYADER (TFHR)
	(17) Human Capital & Mobility	L. BELLEMIN (DG XII)
	(18) SPRINT	R. MIEGE (DG XIII)
	(19) Comments	
12H30	*Lunch*	
14H00	(20) Roundtable Discussion: **Policy Perspectives** (21) - at regional level (22) - at national level - at Community level	R. MIEGE (DG XIII)
15H15	(23) Closing	
15H30	End of the workshop	

COMMISSION OF THE EUROPEAN COMMUNITIES
DIRECTORATE GENERAL
Information Technologies and Industries, and Telecommunications
RTD : Dissemination and exploitation of RTD results, technology transfer and innovation
Innovation and technology transfer

Luxembourg, 24th May 1993

Workshop on

"PUBLIC MEASURES TO PROMOTE THE ACQUISITION AND DIFFUSION OF TACIT KNOWLEDGE"

Luxembourg, 25-26 May 1993

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EIMS

EUROPEAN INNOVATION MONITORING SYSTEM

EIMS' broad aims are to collect and disseminate information on innovation and technology transfer, and to organise a permanent and interactive system for producing and using this knowledge.

More precisely, EIMS aims at:

- Monitoring of innovation and diffusion in Europe and evaluation of support measures
- Strengthening of the exchange of experience between the member states and the Commission in the field of innovation policy and technology transfer
- Providing all interested parties with information, analysis and research on the factors shaping, promoting and inhibiting innovation at the company level across Europe
- Reflecting the increasing need for reliable information as a foundation for formulating innovation policies in the phase of the major changes in the innovation environment and especially the characteristics and different types of innovation within SMEs.

EIMS activities are organised in the six main areas:

1. Evaluation
2. Innovation in firms
3. Innovation and technology transfer supporting infrastructures
4. Regional aspects of innovation (capabilities, infrastructures and strategies)
5. Innovation financing
6. Innovation policy.

Further EIMS publications

1. **An integrated Approach to European Innovation and Technology Diffusion Policy: a Maastricht Memorandum, L. Soete and A. Arundel, 1993**

2. **The Community Innovation Survey: Status and Perspectives, 1994**

3. **Innovation Activities and Industrial Structure: Industry and R&D in a Comparative Context, T. Sandven and K. Smith, 1993**

4. **Investment, Innovation and Competitiveness: Sectoral Performance within the Triad, A. Wyckoff, 1993**

5. **Patterns of Innovation in Italian Industry, G. Sirilli, R. Evanglista, M. Pianta, 1993**

6. **Innovation Structures and Performance in Nordic Manufacturing Industry, A. Kristensen, 1993**

7. **Public Measures Supporting New Technology Based Firms: Proceedings of the SPRINT/EIMS Policy Workshop, P. Boekholt, and G. Fahrenkrog, 1994**

8. **Policies to Support Tacit Knowledge Transfer. Proceeding of the SPRINT/EIMS Policy Workshop, Luxembourg 25-26 May1993, G. Fahrenkrog, P. Boekholt, J. Howells, V. Mangematin, and G. Schütte.**

9. **Surveys of Regional Innovation? A Feasibility Study for Europe, N. Alderman and M. Wood, 1994**

The reports can be ordered from
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