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**Services in European
Innovation Systems -
A review of issues**

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Abstract

This paper is an outline of some of the issues that are addressed in the TSER funded project, SI4S - Services in Innovation, Innovation in Services. In the paper we discuss the role of services, with a particular emphasis of knowledge intensive services, in innovation processes. We address both issues related to innovation in a variety of service sectors, and issues related to the role of different services towards innovation in other sectors.

Sections 2 and 3 give a brief summary of some stylized facts about innovation in services. We describe the objectives and contents of the SI4S project in sections 4 and 5. The paper ends up by addressing some policy issues that are raised when service sectors are included in the framework of S&T policies. The paper suggests on this basis some policy recommendations for innovation policy formulation at the EU level.

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1 Introduction

There is a considerable gap between the present efforts to understand innovation and other change processes and the effects of the structural changes in national economies. While service sectors, though widely disparate in terms of their role in the economies and their interrelations with other economic sectors, account for about two-thirds of the overall employment in the European economies and include the most dynamic sectors in terms of employment growth over the last decades, they have not received a similar attention in the innovation literatures.

Similarly there has been a significant under-focussing of related issues in the formulations of national industrial and innovation policies; industrial policies have to a large extent been manufacturing industrial policies. The focus on manufacturing competitiveness and technological innovations primarily in manufacturing industries has led to a weak integration of service related issues in these policies, and a concomitant weak reflection of these sectors in innovation related policies and infrastructures.

This has also been reflected in a view of service sectors as ‘employment sponges’ and productivity laggards. With service sectors as supplier-dominated technology users, they have been accorded a restricted role in terms of innovation and change, both within their own sectors and in the role they have played towards other economic sectors.

Recently, however, there has been a significant increase in the service focus in innovation and industrial policies, both at a national level and at the level of the European Union. The EC 1993 White Paper on Growth, competitiveness and employment struck one important note in saying that

“The wealth of nations is increasingly based on the creation and exploitation of knowledge ... The shift toward a knowledge-based economy is reflected in particular in the externalization of certain activities by industrial firms and by the faster growth of services. It does not mean that manufacturing industry is declining in importance, since this sector is at the very heart of this development and continues to determine the overall competitiveness of the productive system.

The key elements in competitiveness that are now of greatest importance are no longer confined to the relative level of the direct costs of the various factors of production. They include in particular the quality of education and training , the efficiency of industrial organisation, the capacity to make continuous improvement in production processes, the intensity of R&D and its exploitation, the fluidity of the conditions under which markets operate, the availability of competitive service infrastructures, product quality and the way in which corporate strategies take example of the consequences of changes in society, such as improved environmental protection.”¹

This approach of the White Paper, of considering the inter-relations between economic activities, and the role of immaterial developments in knowledge and organisation, imply a reassessment of the role of services in the processes underlying productivity, competitiveness and employment growth.

Following up the White Paper, the recent Green Paper on innovation² enumerates services as innovative but unrecognised sectors, “the priority given to it in analyses

¹ EC, Growth, competitiveness, employment - The challenges and ways forward into the 21st century - White Paper, Bulletin of the European Communities, Supplement 6/93, Luxembourg 1993, p. 62

² EC 1995, Green Paper on innovation, Bulletin of the European Union, Supplement 5/95, Luxembourg 1996

and innovation policies is far from commensurate with [their] influence” on innovation and innovative performance. The Green Paper does not however make any attempt at developing a framework for innovation policies that encompasses these influential sectors.

A similar sign of a reorientation of economic policies is ongoing work of the OECD. The examination of “the relationship between productivity, job creation and technology” that was requested from the G7 Jobs Conference in 1994 is now being concluded, through the finishing of the analytical report. The draft report³ represents something new in the area of policy-oriented work in this area. Through an attempt at an integrated perspective of structural changes in industrialised economies, services and issues related to service development in productive structures are given a focus commensurate with their role in the change processes currently impressing industrialised economies. Similarly the process of drafting the coming edition of the Science and Technology Policy Outlook starts out with noting a ‘coming of age’ of the advanced ‘service economies’; the 1990-1992 recession was the first time the service sector component dominated the decline. This has implications for economic policies; growth patterns and cyclical characteristics of dynamic service sectors have serious repercussions on how economic policies are framed.

As regards science, technology and innovation policies the trend over the last decades has been from industry- and sector-based ‘support’ policies towards framework enhancing policies, amending the background and the prerequisites for efficient innovation processes. The shift towards framework industry policies opens up for, and is to a large based on, a dissolution of industry specific policies and more industry neutral industry policies.

Concomitantly with the increased character of industry neutrality, the framework character opens up for a more prominent role for interrelations and dependencies across industries and sectors. There is ample evidence that the role of services in these interrelations is strong and increasing. The growth of industrialised countries over the last few decades have been characterised of significant structural shifts, whether they be called de-industrialisation, the advent of an information society or knowledge-based economy.

Equally striking is the degree to which these issues have been under-focused in the innovation literatures and policies. When the British Chancellor of the Exchequer Nigel Lawson as recently as 1988 claimed that future employment growth would be in the service sectors, and that henceforth “new jobs will be not so much low-tech as no-tech”, he was expressing what was the accepted public opinion about the future of the industrialised countries. On the other hand the OECD Technology/Economy Programme epitomised a changed agenda of national industrial policies; increasing the focus of innovation processes and their systemic aspects. But both the TEP-programme and the development of the OECD manual of innovation indicators, the so-called Oslo Manual, has a glaring ‘manufacturing’ bias. Associated with this manufacturing bias has been a restriction of the conceptualisation of innovation, particularly as regards technological innovations, that has been primarily amenable to innovation in manufacturing industries (and even possibly restricted there too). Product and process innovations was two out of five categories of innovations that were classified as important by J. Schumpeter.

Until fairly recently the common perception of services as a residual category of industrial activity was characterised by low productivity growth. The lower produc-

³ OECD, Technology, productivity and job creation, Analytical Report, OECD Paris 1996

tivity growth and the technological supplier-dominance of services, with weak feedback linkages from service industries to technology-developing sectors, was what lead to the predictions of either a cost-disease as described by W. Baumol or to a push-button 'self-service' economy a la J. Gershuny. But the development of several producer services, as financial services, telecom-related services and engineering/consultancy services into significant technology users, including some of the most (primarily information) technology-intensive sectors of national economies, makes it extremely unlikely that they should not have a decisive effect on the development of their suppliers and customers.

2 Services and innovation - the supplier domination

This is not the place to speculate in the reasons for the neglect of service dynamics. Some attempts have been made to analyse innovation processes from a service perspective. Not the least the two pilot surveys that were performed during the Community Innovation Survey in the Netherlands and Germany. The Dutch data seem to confirm the traditional picture of services as being predominantly supplier led. On the other hand the 'ordinary' CIS data would seem to offer a glimpse into the interactions of manufacturing innovation processes with certain services, if we consider the questions related to information and technology sources for innovation processes.

Based on this assumption, the service sectors seem to play a marginal role in innovation processes in most countries (as far as analysis is available), along with other institutionalised inputs like research based in higher education institutions. I would venture however to give as a hypothesis that the data will show that though service like functions does not play a significant role there will be a particular size and a industry structure in these data; that the prime beneficiaries of the relevant functions as indicated by the CIS questionnaire will be primarily large firms and hi-tech industries, according with the knowledge intensity of the implied services.

Together these data sets seem to offer a bleak prospect for services' role in innovation. But this conclusion warrants a consideration of the concept of innovation in general, especially in certain knowledge intensive services, and the concepts of product and process innovations in services in particular. A further project initiated by the EIMS on knowledge intensive business services⁴ has shown a wide spectrum of innovation strategies and processes in such services, and has outlined a tripartite classification of innovations in services into product, process and delivery innovations. But furthermore it raises questions to the measurement of indirect, possibly critical, inputs into innovation processes.

The analysis of 'systemic' features of economic change and innovation has broadly speaking led to three complementary system-approaches; the learning and knowledge-generating aspects emphasised by (national) innovation systems, the technology trajectory focus of technological systems and the role of horizontal and vertical economic linkages, and hence industrial structures, in moulding the competitiveness of industries, as in 'industrial clusters' a la Michael Porter. 'Systemic' frameworks like these offer a perspective that open up for a more integrated approach to innovation in service sectors and to the role played by services in other sectors.

These systemic approaches has led to an increased awareness the role of services towards manufacturing innovation, but has to a lesser degree led to a focus of service innovation. Nevertheless it is reasonable to conclude that in distinguishing diagrammatically between innovation in service functions and the role of service functions towards innovation processes in other sectors, the literatures on the first aspect is somewhat more elaborated than on the second. But there is a definite need of further mapping and analysis of both aspects, and the impact on policy formulation.

⁴ I. Miles &al, Knowledge-intensive business services - Users, carriers and sources of innovation, EIMS publication no. 15, 1995

There is however an area where the impact on policy formulation has indeed been direct and visible. There has been an increased focus in innovation policy measures of knowledge intensive services as 'extension services', a generalisation of the role of knowledge generating research institutions in the same policies; see f.i. Bessant and Rush's recent article in *Research Policy*. The OECD publication 'Boosting businesses - Advisory services' gives an overview of initiatives in several OECD countries. This is evidently done with an underlying assumption of a significant transfer ability of these services, and a decisive impact on the innovative performance of their customers.

3 Services and technology - stylised facts

The dynamism of several services in terms of creation of new services and regeneration of old does not suggest that service sectors should in any sense be innovation sluggards. Rather the contrary; in several respects services contribute to the dynamism in modern economies in a significant way.

There are a set of basic characteristics that form the starting point of a project like the SI4S. First of all it is important to keep in mind the heterogeneities of the service sectors, both in terms of economic and industrial characteristics, and in terms of supply and demand patterns. This suggest a varied structure in terms of innovation patterns and in terms of their role in innovation systems.

Secondly, this raises questions that are also valid for other economic sectors, but which seem to be more poignant when focusing service sectors. First of all this relates to the role of technological innovations, to the concept of innovation itself and to the role of 'intangible' innovations.

But even restricting the focus to the role of technology we have already noted the increased capital intensity of several services. There are two considerations to this. Not only has the capital intensity increased, but concomitantly there has in some services been a relative shift from plant (buildings/fixtures) to machinery and equipment. Secondly this is to a large extent related to investments in information and communication technologies. The following table is adapted from the recent study commissioned by the US National Research Council, showing that more than 80% of US investments in IT hardware were in non-governmental services. Relative to value added and employment the distribution of IT hardware investments has a stronger bias towards non-governmental services, particularly for communication and FIRE services.

Table 1 US structural distribution of value added, employment and investments in IT hardware, 1991.

	<i>Value added</i>	<i>Employment</i>	<i>IT investment</i>
<i>Manufacturing</i>	21,7 %	21,2 %	16,5 %
<i>Total goods sector</i>	30,5 %	29,2 %	17,4 %
<i>Transportation</i>	3,6 %	3,9 %	2,5 %
<i>Communications¹</i>	2,5 %	1,4 %	13,7 %
<i>Retail and wholesale trade</i>	17,3 %	26,0 %	22,8 %
<i>FIRE²</i>	17,7 %	7,7 %	25,2 %
<i>Other services³</i>	25,9 %	30,7 %	13,2 %
<i>Total service sector</i>	69,5 %	70,8 %	82,6 %

¹ Including broadcasting

² Financial services, insurance and real estate

³ Includes health care and delivery, business services, legal services, hotels and recreation

This is in accordance with the conclusion drawn by Ken Ducatel and Ian Miles in a recent study if IT diffusion in Europe. For the UK the highest spenders on ICT hardware were telecom, banking, retail trade and repair and business services. About 3/4 of investment in computers and telecommunications equipment is in services.

We will characterise the role of technology and technological innovation in services by the following five points that represent the main hypotheses to be made at the present time. These points emphasise the need for a better understanding of change and innovation processes in services and they open up for significant effects of a public policy towards these processes. At the same time the crudeness of the conclusions indicate that there is an ‘ample supply’ of open questions that must be answered before any definite conclusions may be drawn as to specific policy implications.

Table 2 Services and technology - the main hypotheses

<i>Technological aspects of services</i>
<i>Services are major users of new technology</i>
<i>Services are major originators of new technology</i>
<i>Services are agents of transfer of new technology</i>
<i>Many services are poorly integrated with the knowledge infrastructure</i>
<i>The internal innovation and knowledge organisation of services is weakly formalised</i>

Services are often characterised as being supplier dominated, referring to Keith Pavitt’s sectoral classification of innovation trajectories. This would mean in particular that their technological innovation trajectory is dominated by suppliers of capital equipment, with innovation pre-eminently being capital-deepening and labour-saving process innovations. Industries that are characterised by supplier dominated technological trajectories have a significant overrepresentation of small firms, that primarily appropriate innovation benefits through non-technical methods, such as marketing, aesthetic design and reputation mechanisms.

As we have seen above some of these features may be recognised as, even generally, valid characterisation of several services. But they also show the inadequacy of a strict technological approach to innovation in services. Even though the process innovation dominance would seem to be generally true for many services when the focus is restricted to material technologies, it is equally evident that this is a gross misrepresentation of non-technological innovative effort in communication, financial and business services. We will see later that there is ample evidence for allowing a much richer characterisation of services’ innovation trajectories than restricting it to supplier dominant ones.

One immediate indication that suggest the inadequacy of the ‘supplier dominance’ approach to services is the evidence underlying the patterns of increased capital intensity. The capital intensity of financial and communication services imply that these sectors include some of the most capital intensive industries, and hence dominant technology users, in the G7 economies. If this is the case it is highly unlikely that they do not play a substantial role, directly or indirectly, in the shaping of the technologies in which they are heavily involved.

The supplier dominance of services is being challenged from other indicators as well. It is only during the last few years that systematic efforts have been made to cover selected service sectors in the national R&D surveys in OECD countries. Fifteen years ago the general attitude was that the mis-measurement that this created was not substantial; estimations based on the R&D statistics indicated that services represented of the order of 5% of national business sector R&D. During the 1980’s this situation changed dramatically. As business service sectors were included in the

surveys, the services' share of business R&D expenditures quickly rose to 20-25% in several countries, making knowledge intensive business services the largest source of intermediate embodied R&D.

On the basis of Pavitt's classification it seems that services are assumed corresponding to the category of supplier dominated trajectories. Service firms are with a few exceptions small, they are perceived to have a weak or at least a more diffuse organisation of innovative activities, relying heavily on adaptation to user needs. This viewpoint may be further reinforced by the dependence on significant IT investments in several service sectors, particularly in ICT and financial services, as well as business services (in the NACE sense).

Likewise appropriation of innovation benefits of services is often claimed to be oriented towards non-technical regimes of a similar character to the ones described for supplier dominated trajectories in the table below. Examples of this is 'brand-naming' strategies and the stronger role played by trust in user-producer service relations, f.i. with consultancies, and marketing strategies as in tourism.

The suggestion is that this classification is not satisfactory. The reasons for this are several and some have been touched upon in the preceding paragraphs. Luc Soete and Marcella Miozzo have suggested an extension of the Pavitt classification to services. Three categories of services are distinguished in this classification, supplier dominated, scale intensive service trajectories and science based/specialised supplier services. It is difficult to distinguish between the last two as the services falling in this category are often closely related to information and knowledge generating processes.

Supplier dominated firms, encompassing the common perception of low wage service activities with small scope for productivity growth⁵, even to the extent of questioning their productivity, may be found in personal services, like cleaning and laundry, hotels and restaurants (and Adam Smith's menial servant and his descendants), as well as in public services, as education, health and public administration, and retail trade. Apart from public services, these services have traditionally been supplied by small, even micro-small, organisations, (organisations providing public services are usually large).

But there has over the last few decades been interesting structural changes in several of these, both as related to development of large organisations and chain concepts. F.i. within hotels and retail trade companies has found it profitable to develop chain concepts that has changed substantially how these service sectors are organised and their relations with customers and suppliers. Even within 'low-skilled' services like cleaning there has been significant changes, as Jon Sundbo's studies of the Danish multinational service company ISS have illustrated. Starting out from cleaning services on the domestic market in the 1960's, ISS today has an employment of around 140 000 in 17 foreign countries in Europe and the Americas, today supplying a wide range of manual business services, as environmental and other technical cleaning, catering, manual hospital services a.o.

Scale intensive firms is in the table divided into two groups of firms; physical services like transportation and wholesale trade, and 'network' intensive firms or sectors as banking, insurance and other financial services, as well as large scale communications services like broadcasting and other communication services with significant network externalities. As pointed out by Soete and Miozzo there is a wide

⁵ The archetypal services being shoe shining, hair cutting and hamburger flipping.

range of reasons behind the growth of these services, also associated with significant productivity increases over the years.

Transportation and increases in regional and global trade have for many years partaken in a mutually reinforcing dance of increasing intensity. The growing markets for transportation services has supported the Smithian conjecture about division of labour and market size, both within transportation sectors and firms and between different modes of transportation. This process has had tremendous impact on technological development, through the need of better and diversified transport technologies, with the development of whole transport clusters, and the complementary development of infrastructure technologies, like surveillance systems, road building etc.

The network intensity of these services make capacity utilisation and process flows critical. As pointed out by Rosenberg, and reiterated by Pavitt, production 'trouble shooting' enhances the development of in-house production engineering capacity, since "it is difficult to make ... scale-intensive processes work to full capacity. ... [T]rained and specialist groups for 'production' and 'process engineering' ... develop the capacity to identify technical imbalances and bottlenecks [improving] productivity", growing into a vital source of process technologies in these industries. A similar pattern is visible in scale intensive services.

Specialised suppliers and science based firms comprise a diverse set of activities, but are generally of two overlapping kinds. IT intensive activities might broadly be said to fall into two categories, as suppliers of IT based products, primarily software, or as 'network' services. The other group of firms includes specialised business services related to information generation, synthesis and retrieval, and advisory, creative and specialist service functions.

It is evidenced by other indicators, that services are major destinations for scientists and engineers, especially but not only in ICT specialisations. Particular services are heavily involved in the flow of technological knowledge through the economy and society. The strengthening of interactions between manufacturing and service sectors is common to many European economies. By virtue of their wide network into the business sector some services with a strong technology or knowledge element may play a pivotal role as vehicles for diffusion of new technologies throughout the economy. Being major employers of scientists and engineers they will also be a major source of specialist knowledge and for access to advanced networks.

Despite the importance of technology for existing services and for constituting new services, it is notable that there are few research institutes, training courses, or other elements of the knowledge infrastructure that are oriented toward services and services development.

On the basis of the available literature we may also conclude that they are less likely to set up R&D departments or similar development agencies. It seems that service industries are more likely to set up developmental activities on a project basis or to perform such activities in integration with 'ordinary' activities. There is a strong preponderance of SMEs in several services, a fact that may a large part of the answer for the 'paradox' that services, facing strong pressures towards change, does not seem to respond with formalising development activities in a manner similar to larger scale manufacturing industries. This 'SME-like' pattern of innovation seems however to be stronger than what is suggested by the size spectrum alone. It is an open question whether this reflects the emergence of new 'net-work' based modes of innovation or if it reflects a lag in service companies 'industrialisation' processes.

One characteristic feature of several 'new' service sectors is a fluid, ever-changing industrial structure. This in itself raises important questions for policy formulation as regards its level of attention. Furthermore, knowledge and technology infrastructures seem to be less adapted to the needs of services than to those of agriculture or manufacturing. The lesser formalisation of innovation processes, have led to service organisations being less able to articulate their needs for strategic research than their manufacturing counterparts. Partly this is due to service innovation often requiring integration of cross-technological, organisational and social factors. This points to one suggestion that will be made, that the critical knowledge bases of several services are more diversified and diffuse than typical knowledge bases of manufacturing industries. But it is probably also a consequence of the less clear-cut industrial structures, implying relatively more weakly developed industrial superstructures, like industrial associations and networks, industry-based interaction with public authorities etc.

In spite of lesser formalised R&D and innovation activities in services, there is strong evidence that some services are as R&D-intensive as most manufacturing sectors. The non-technical appropriation of service innovations, combined with a weaker position for, formally or informally, intellectual property rights (IPRs), could imply that these innovations are more susceptible to copying and imitation, implying a significant disincentive to innovate in services. The recent case studies of knowledge intensive business services performed by TNO and PREST has shown, however, that an increasing number of 'strategies' or 'regimes' have been developed to ensure profitability of service innovation.

A set of studies in addition raises doubt as to the general validity of conclusions that the growth of several service sectors are an effect of a 'unbundling' in manufacturing, often epitomised as the make or buy decision. Available evidence suggests that processes of unbundling are at least paralleled by increased vertical integration, one study by P. O'Farrell also finds a stronger tendency of integration than of disintegration. This suggests that the increased use of services is a real effect, even to the extent of being underestimated by available statistics. This finds some support in the development of employment in manufacturing industries, with an increase in the employment of qualified white collar staff hidden behind the general 'deindustrialisation' trend of these industries.

To sum up there are compelling indications of increasing importance of service sectors in the processes of technology creation, that is

Service sectors are major users, originators and agents for transfer of technological and non-technological innovations, playing a major role in creating, gathering and diffusing organisational, institutional and social knowledge.

The hypotheses described above can be portrayed as follows. In many respects, *manufacturing and services differ quantitatively more than qualitatively.* Furthermore, the grand sectors overlap - some services, especially new technology-based business services, share many features with the more advanced parts of manufacturing, while some manufacturing industries resemble the stereotype of services. And we argue that the *overlap is growing* - there is a convergence of sectors, though each still has much internal diversity.

4 Main challenges for SI4S

From this our objectives of the SI4S programme are twofold;

- to map and analyse the changing role of services and service in European innovation systems,
- to design, formulate and integrate options for innovation policies and business strategies.

The programme will include studies of innovation activities in services themselves as well as service firms role in creation and diffusion of innovations in other sectors. It will describe the role of services in re-shaping and enhancing national and European systems of innovation.

The programme consists of a combination of structural analysis on the macro- and meso-levels and thorough survey and case studies on the micro-level to give cross-fertilisation of approaches across the macro-/meso- and micro-level interface.

An analysis of innovation activities across countries and industries allows for an identification of political and institutional, as well as of market specific and industry related, determinants. Innovation networks or systems, including also the relationship with a public knowledge infrastructure, are often expressions of underlying strategies for internalising benefits of innovations into the networks. As such the networks are also expressions of modes of appropriating these benefits.

The questions the SI4S project will emphasise include,

- business services and their role in innovation processes,
- knowledge intensive business services as 'diffusion agents',
- service provision and innovative capabilities,
- innovation strategies and complementary assets,
- appropriability regimes,
- services' links to knowledge infrastructures and innovation policies.

The project forms a pilot step as a first integrated transnational approach to these issues. The 'industrialised' countries are already advanced service economies. Typically service sectors represent more than two-thirds of employment and a substantial fraction of the value-added in these countries originates in the service sectors. Industrialised countries are undergoing significant structural and socio-economic changes, with services playing an important role in these changes. Many sectors of economic activity is running through phases of rapid internationalisation and globalisation, restructuring competitive markets and potentialities for growth. International integration and processes of national deregulation imply changed 'rules of conduct' for previously nationally based service activities.

With these aggregate trends it is paradoxical that service activities is a blind spot in many national innovation and technology policies. It is important to resolve this, for the industries themselves and for allowing formulation of relevant innovation policies. The activities of the SI4S project will allow developing recommendations for the formulation of national and European innovation policies, with a scope encompassing the complementarities between different economic sectors. By mapping services' roles towards innovation and change and study their implications,

the results will also be valuable to the business community as a background for formulating and implementing innovation and management strategies.

5 Policy relevance of the SI4S project

The member countries of the EU and the EEA are already advanced service economies. Typically service sectors, or the tertiary sector, as defined through public statistics represent more than two-thirds of employment. A substantial fraction of the value-added in any one country originates in the service sectors. Industrialised countries are undergoing significant structural and socio-economic changes, with services playing an important role in these changes.

Many sectors of economic activity is running through phases of rapid internationalisation and globalisation, restructuring competitive markets and potentialities for growth. International integration and processes of national deregulation imply changed “rules of conduct” for previously home-based service activities. With these aggregate trends it is paradoxical that service activities is a blind spot in many national innovation and technology policies. It is this paradox that this project is aimed at resolving.

The concept of innovation systems has been widely, and appropriately, adopted by both policy analysts and policy makers, as a tool which help them to grasp the increasingly complex interdependencies of sectors of economic activity and public policy in determining the pattern and outcome of innovation processes. With innovation as a key determinant of economic growth and competitiveness, the focus on *innovation systems* epitomises the vital role of innovation and technology policies in the process of long term economic and welfare development.

The ability of European societies to improve competitiveness, social welfare and quality of life, as well as sustainability of the environment, not the least given the cogent issue of present unemployment levels, is crucially dependent on the ability to generate competitive assets on increasingly globalised markets. The enhanced importance of technologically based market competition emphasises the need for policies aiming at development of innovative capabilities and generating technological variety in maintaining and developing social welfare. This complementary relationship between welfare and market-based variety generation places a heavy demand on the knowledge of the systemic aspects of innovation processes. During the last two decades a wide range of studies have elicited these aspects to the degree that some patterns have emerged.

It is our contention that another characteristic development of the Western societies in the post-war period, the emergence of *service economies*, points to an important element that is lacking in most of these studies. Many traditional explanations of this development seem to give services a simple role in terms of innovation dynamics, primarily as recipients of innovations developed elsewhere. Services are only featured indirectly in most innovation policies - if considered, they are mostly regarded as agents for technical training and support policies towards manufacturing firms or as technology sinks, benefiting from their supplier-dominated character.

This tendency to overlook the services is seemingly supported by the received wisdom of innovation theory in various ways. But there is a self-confirmatory element in such approaches - by assuming that services' roles are negligible, instruments and approaches have been developed which make it impossible to accurately examine these roles. But service functions seem to play a central role in structural change in the business sector that extends well beyond a management based transactional economy, it seems clear that we are only at the beginning of

understanding the role of service functions, and service sectors, in innovation systems.

In spite of the importance of service activities in innovation processes, it is difficult for service considerations to be integrated in the concerns driving the design and implementation of technology and innovation policies because of the lack of understanding of the underlying dynamics. It is this paradoxical situation that this programme aims to address.

Services are important elements in the creation of competitiveness, growth, and employment. The extent and importance of knowledge creation and use in services and the complex interrelations with other sectors and activities, raise fundamental issues concerning the role and significance of services in innovation and innovation in services.

Our aim is to develop recommendations for policy formulation towards national innovation policy makers, with a scope encompassing the complementarities between different economic sectors. The recommendations that emerge from this study will by their scope facilitate the inclusion of the systemic aspect of innovation and structural processes, as well as development of a *sui generis* service innovation policy.

The European integration process implies the continual development of a European innovation and technology policy supplementing and enhancing the value of national policies. The same points as described above apply to the European trans-national level. In addition the continual deepening of the European integration means a growing importance of genuine European frameworks for services.

It is too early, we are still in the initial phase of the project, too draw any definite conclusions as regards policy implications and recommendations emanating from the project. But we will in the last sections suggest some themes that are relevant for policy formulation in this perspective.

But first let us raise one important issue; though it is usually stated there is (almost) no such thing as a service dimension to innovation policies, that does not imply that innovation and technology policies are irrelevant for services. There are two dimensions to this. First of all, the participation of services in economic and technological networks imply a 'spillover' effect to services, as well as a more direct interaction in that the object of publicly initiated R&D projects are often directed at technologies that are of direct relevance to groups of services, even to the extent that some service categories are probably the main users of these technologies. A case at hand may be control, tracking and surveillance systems.

But secondly, considering the concept of innovation policies beyond the limited context of direct innovation support policies, there are no doubt that these policies have significant effects on innovative performance involving services. It is an open question however how they affect innovation processes in services.

6 Services in EU S&T Policy

As the Green Paper on innovation states, the service sectors are unrecognised in the formulation of innovation policies in most countries. There are three issues that are of direct relevance for policy formulation in considering services. First, the role of appropriation of innovation benefits is the immediate incentive to innovative performance in business companies. Services innovation are often claimed to be easy to copy, and hence that services are experiencing weak appropriability regimes. Whether this is true or not, it nevertheless points to the inapplicability of traditional IPR measures for several services. To the extent that the assumption is correct, there is a definite need of strengthening the appropriation mechanisms towards services.

We also pointed to the weak external formalisation of services needs and development strategies, as the organisation of the public support system, such as technological infrastructures. Some of the policy relevant issues that are raised are

- * importance of user-producer-supplier relations reflected in such processes as co-development, externalisation and interaction (network character of service innovation);
- * combination of product, market, process and innovation in the delivery of services;
- * opportunities to appropriate the value of service innovation are possibly harder;
- * broader concept of R&D that applies to service innovation (soft side of innovation is more important, see below).

From this we may suggest areas for policy implications,

Including services in regular policies and statistics. The weak coverage of services in R&D and other economic statistics is well known. The recent extension of R&D surveys in several countries to include services has been most welcome. Equally the ongoing implementation of the new SNA, as well as the implementation of NACE, implies a step forward, away from the outdated categorisation of services as of 1968. A better statistical description of service sectors is a prerequisite for better policy formulation.

R&D process in services seems often to be organised on an ad hoc or on a project basis. R&D as registered in surveys seems also to be concentrated in a restricted set of services. Strengthening R&D processes in services involve several issues, such as the nature of the R&D challenges and the character and role of knowledge generation in services. Some services are themselves knowledge generating or transforming, other services may be characterised by diffuse knowledge bases. The SME character of services. Processes of modularisation and industrialisation of some services.

There are scope for mapping best practice services innovation policies, involving development of a taxonomy of policy measures towards services, the role of service related infrastructures.

6.1 Services and S&T policies

This last section is more specifically directed towards policy formulation at the EU level. In considering European level S&T policies, of which the RTD policies forms a substantial part, several issues are raised. A first set of issues are related to S&T policies in general, a second set to the European dimension of European S&T policies. Though these sets of issues are not mutually excluding, the first set would

include issues about the rationale, scope and scale of S&T policies, while the second set should raise issues concerning the role of European level policy making.

The possibility of discussing these issues in any general sense is strongly contingent on the choice of scope with which one considers particularly technology and innovation policies. Usually there are three levels of rationales and general objectives, corresponding to three levels of scope of such policies,

- a wider welfare argument, of broad social and cultural needs and development,
- rationales related to national competitiveness and value-creation, often legitimated as national economic wealth generation to enhance economic welfare, and
- a 'restricted' rationale of policies aimed directly at innovative performance, innovation policies in this context being restricted to policy measures directed at support policies that have as their prime aim to enhance innovation activity in the economy.

All of these rationales require considerations of the division of roles between public and private sectors. Only by doing this, is there a real possibility of efficient utilisation of the potentialities of cohesion and co-ordination between the two sectors. It also seems evident that the scope of this discourse is strongly related to the kind of rationale and objectives that is used for public policy.

But this requires a greater 'visibility' of the role of public authorities, clarifying the rationale of the different interacting roles and objectives of relevance to innovation policies and elucidating the balancing of different policy objectives and the criteria for this process.

Service sectors and firms are dominant in the European economy, in terms of employment and output. But they are relatively neglected in discussion of S&T policy. The issue of European competitiveness is usually seen as a matter that largely concerns manufacturing. This should be qualified however, in that services do slip into S&T policy in several ways:

- some technology development and diffusion programmes are explicitly oriented to service users - DELTA, AIM, the various schemes for utilising telematics in public administration, etc.
- some of the technologies being developed are the province of service firms, especially in such sectors as software, telematics, etc.
- the telecommunications infrastructure in particular has been supported by programmes such as RACE and regional support measures.
- education and training are seen as critical actors for developing the human resources for S&T activity.
- services benefit from many programmes of technology transfer - for instance the majority of the entries on the CORDIS database are service companies.
- some national and regional programmes which are part-funded by the EC do focus on services - an example being Ireland's Small Business Operational Programme's Measure 3 (Promoting and Supporting the Development of Service Business).

But, even if services do feature in EC S&T programmes in ways such as those outlined above, these sectors still need more explicit analysis and attention for a number of reasons:

- Services are important not only because of their bulk in European economies. They are also because of their increasing importance in innovation systems. They are sources of innovation themselves (as indicated by, for example, the growing share of R&D associated with service firms). They can also be elements of

innovation networks. Knowledge-intensive business services (KIBS) are particularly prominent here.

- The fact that some services gather more or less attention does not mean that all services do so. The diversity of services has to be acknowledged - some are undoubtedly lagging in terms of innovation, and some (not necessarily the same ones) are underrepresented in European programmes of the type mentioned above.
- A final reason for paying more attention to services is that, although these are diverse sectors, they do frequently share some characteristics in common - high client-intensity, intangible products, etc.. These characteristics are associated with the neglect of their role in innovation, and with the difficulties in measuring services innovation. And these characteristics are ones which are arguably becoming more prevalent throughout the economy, as manufacturing firms become more client-responsive, compete more in terms of service elements of their activities, adopt shorter product life cycles, etc. It may well be that attention to services innovation will help highlight many features of the new forms of innovation which received policies and instruments may be failing to capture.

6.2 Requirements for Research and Measurement

Despite the increasing attention they are receiving, services are not well understood, especially where innovation processes are involved. There are good reasons for believing that these innovation processes are frequently distinct from those characterising manufacturing innovation. Some of the requirements for further research are:

- The neglect of services in innovation and R&D studies - and especially surveys - thus needs to be addressed. Services need to be consistently sampled in surveys which use established methods and definitions.
- It is important to examine how far concepts, definitions and indicators of R&D and innovation (i.e. of related activities, expenditures, organisation, outputs, etc.) need to be restructured to take into account the activities of service firms. For instance, attention to **collaboration** in innovation between service suppliers and users, and to **delivery** as a distinct area alongside product and process innovation where technological change is prominent in services, would almost certainly be worthwhile. The peculiar **IPR** situation of many services may mean that patent and related statistics are not appropriate to these sectors.
- Better statistics are required on many facets of services - new services, producer services and KIBS in particular. Despite the difficulties of keeping statistical systems aligned with rapidly changing, new, and possibly transient sectors and specialisms emerging, it has long been recognised that many new business services are hidden within a “not elsewhere specified” category. Other important areas have been unhelpfully merged with established groups (e.g. telematics services with computer services in the UK); in many data sets post and telecommunications are still merged!
- The neglect of services in innovation and R&D studies - and especially surveys - needs to be addressed. Services need to be consistently sampled in surveys which use established methods and definitions. However, some modification to survey instruments, as well as to samples, may be required, as addressed in the next point.
- It is important to elicit systematic information on a number of policy-relevant topics where decisions applying to services currently seem to be taken on the basis

of anecdote and assumption. For instance, the role of IPR and protection as an influence upon innovation strategies, is uncertain. Claims in the literature suggest that the (allegedly high) appropriability of service concepts - service innovations are frequently easy to identify and copy - inhibit innovation. But there are somewhat contradictory results from some case study work, where the threat of imitation is rarely raised as a deterrent. High-level work is required to establish appropriate policy guidance on IPR issues as they affect KIBS (Knowledge-Intensive Business Services) in particular. This work should involve substantial inputs from a broad spectrum of stakeholders. It should examine critical sectors first, without necessarily assuming that identical policy implications will eventually emerge for other sectors. It should be sensitive to changes that are liable to occur over time, since the pace of technological change makes this a very dynamic area.

- Policies as diverse as those governing public procurement, professional qualifications, technical standards, and environmental regulations are liable to structure the growth and contribution of innovation-related services. The nature of these influences also requires systematic evaluation.
- Internationalisation of KIBS in particular should allow knowledge and more effective practice to be diffused. But there also seems to be a new international division of labour emerging in services, with some high-level services concentrating in a few metropolises, and there may be problems of diminished competition in some sectors. It is important to understand the trends and also the degree to which barriers to internationalisation persist within the EU single market.
- The role of services in regional development remains more a matter for assertion than systematic evidence (with the partial exception of certain business services such as telecommunications). It is important to know whether regional development can be created by developing particular types of service industries (“service-led growth” - but which services? what role for exports? can key business services be imported without being implanted?), and how this relates to regional development policies.
- Research results in this area are not widely disseminated. Mechanisms for enhancing communication among “service researchers”, and between them and “innovation researchers” are thus important, if the field is to mature at a reasonable pace, and if its conclusions are to be well-grounded and widely diffused.

6.3 Elements of the S&T Policy Agenda

Here we draw attention to a number of key issues and areas.

6.3.1 User-Supplier Relations and Competition

Close user-supplier relations are involved in many services, and trust needs to be developed between the parties concerned. In the case of business services, this trust may be required so that they can exchange “intimate” details of each other’s operations. This may lead to problems - relationships may become too close in certain respects. For example, “lock-in” can develop, beyond the “preferred supplier” or “strategic partnership” models. In general there are dangers of anti-competitive practices). Also professional problems may emerge, where it comes to legally or politi-

cally sensitive activities, or where it comes to working with firms who may be competitors. Such issues ideally might be handled by self-regulation in professional bodies and industry associations. However, self-regulation is liable to be fostered, shaped and even regulated by the policy environment.

Client-supplier relations in KIBS can even extend to the point of joint knowledge development. This poses more problems for measurement of innovation - where has the innovation happened (the service firm might be working on the client's premises, for instance), to whom should it be attributed? More generally, we know relatively little about what constitutes good practice here, and what factors promote successful interaction, although some of the existing research on inter-firm collaboration may be of use. It could be of value to institute programmes allowing for exchange of experience and wider understanding of how to promote successful interaction between clients and service suppliers. What skills are arrangements are best suited to this? Are there lessons that can be exchanged across different countries, sectors and institutional contexts?

6.3.2 Internationalisation

Client-intensity has been one of the factors influencing the trade in services. Many business services have internationalised when major customers have extended their overseas operations. Most KIBS are in principle internationally mobile, but their interactive, client-intensive nature poses barriers to mobility. There seems to be scope for a full review of the extent to which barriers to mobility of different sorts are affecting the development of business services. Some KIBS have been relatively immune from fierce international competition. This especially applies to those associated with spin-offs from governmental organisations such as national research laboratories, to those servicing public bodies where procurement rules may favour national actors, and to those servicing other relatively sheltered sectors. Most KIBS are in principle internationally mobile, but their interactive, client-intensive nature poses barriers to mobility. These issues may need to be tackled by means such as those mentioned under the next subsections.

A question which arises in this context concerns the needs of countries and regions with limited development of business services and other innovative services. How far can such services help to strengthen local innovation systems and innovative milieux? In the absence of a dynamic local sector, can imported services help to kick-start development? What sorts of schemes are required to boost regional access to the resources constituted by KIBS?

6.3.3 Services as SMEs

As the main competitive asset of KIBS firms is knowledge, which is largely embedded in the expertise of their staff, KIBS are often developed by small firms. They frequently face the same problems that other small innovative firms face - particularly in terms of raising start-up and expansion finance. It is important to examine how they are treated within the framework of support to SMEs by national and Community industrial policies. Industrial policy has frequently been criticised for a focus on manufacturing, especially as far as diffusion and awareness programmes are concerned. Even if not explicitly excluded from programmes, small KIBS firms may fail to recognise their own activities in the publicity for programmes of innovation and training support, or in the invitations to join innovative networks. Some

technology (transfer and diffusion) policies have fostered the establishment and growth of KIBS firms, e.g. consultancies providing management awareness services. Lessons might valuably be extracted from the success of SME KIBS who are performing well in these respect.

6.3.4 Services to SMEs

SMEs are also potential users of business services. But KIBS have tended to gravitate toward servicing large companies, with the exception of some specialists in “vertical markets” (i.e. niches). In part this reflects the relatively expensive nature of many of the services. But SMEs are likely to be further deterred by problems in defining their needs and identifying appropriate providers. Support could be available to help SMEs do exactly this. (An example is the Vanguard project with which the UK’s Department of Trade and Industry tried to introduce sectoral communities of firms to the use of EDI and related services.) Support could also be forthcoming for programmes which demonstrate to SMEs the scope for their use of the services supplied by KIBS; this might involve schemes designed to introduce sectoral user communities to appropriate services.

Given that many potential users are concerned about the uncertain quality of the service they might receive, systems of accreditation, quality assurance, and more or less formal dissemination of feedback on performance (even “hit parades”) might be explored. Newer KIBS firms may find that quality standards and awards, and systems for the interchange of experience of use of services, may help overcome the barriers to market entry which they face.

KIBS themselves will probably be required to change their orientations if they are to adequately service SMEs. The nature of the advice and other inputs they make will often need to be tailored to the specific circumstances that such firms face. IT is important that efforts to stimulate use of KIBS do not simply assume that the same messages can simply be disseminated to more clients.

6.3.5 Services, Innovation, and Professionalisation

Services are much less liable to organise their innovation and technology development activities in the modes employed in manufacturing firms - e.g. in specialised R&D departments. It may well be inappropriate for service firms simply to adopt the precise mechanisms used by their manufacturing counterparts. But an exchange of information on best practice, and addition of components concerning training in management of technology and innovation in service management courses would probably be valuable.

Action might be taken to familiarise services, and KIBS firms and SME service firms in particular, with the ideas and practice of R&D and innovation support, and to locate these firms more securely in innovation networks. Actions here could include campaigns, awareness-raising seminars, etc. More ambitiously, centres of service innovation might be established in EU countries as observatories and communication centres generating, compiling and disseminating knowledge about the trajectories of service innovation, the best practice ways of organising innovation activities, etc.

This should result in: increased awareness of innovation possibilities and strategies among a wider range of service firms; speedier response to, and better feedback from, existing policy measures; a more level playing-field will be created for competition between KIBS firms, within the framework of industrial policy

interventions; more access for KIBS to networks of innovators generated by industrial policy. The service innovation centre approach is would probably be the best way for the public sector to facilitate the growth of a European innovation system within the service sector.

KIBS should also benefit from higher levels of professionalisation, in the form of collective fora that would allow them to articulate their points of view, to participate in standardisation processes, and to develop their own quality standards and quality control mechanisms. Stimulating the creation of such fora is an appropriate target for policy.

6.3.6 Training and Education

Training agencies, and research and associated high-level training in Higher Education often display a high manufacturing bias. Thus, many specialised groups research manufacturing technology, while few focus on services technology. (Most specialised groups on services only feature innovation to a limited extent). KIBS face many of the problems of “hybrid management” that have been identified as critical for the knowledge-intensive economy, so ways of fostering the development of such skills are a priority.

Attention is needed to supporting the particular mixes of organisational, interpersonal and technical skills that are required by KIBS. Training and education systems need to be able to develop “hybrid” combinations and entrepreneurial attitudes, and to help establish a better understanding of the innovation process and its management.

6.4 Issues for R&D Programmes

Ultimately, it will probably be seen as less important to distinguish services from other sectors of the economy, than to systematically analyse the range of functions performed across all sectors, and the sorts of innovation associated with each. In the short term, however, there is virtue in focusing on services on account of their general neglect in analysis - and because of the aspects of innovation which are more generally neglected, and which seem to be particularly prominent in many services.

What this means for R&D programmes in practice needs to be explored in more detail. If these programmes are to proceed at least in part by means of task forces, or other modes of organisation based around problems or social needs rather than simply around technological disciplines or perceived opportunities, then it is important to ensure that due attention is given to services in them. (We would stress that this should apply to services of different kinds - not just those involved with information and communications, for example, but also human and physical services; not just conventional public services but also technical and professional services; etc.)

Indeed, problems such as an ageing society, environmental degradation, requirements for lifelong learning, or limitations on mobility associated with dominant modes of transport, are clearly areas where services would have an important role. There is a danger of seeking “technological fixes” - that is, of only looking for technological solutions to these problems, when in some cases social and organisational change may better address their sources or symptoms. But technological changes are liable to be part of any reorientation of services and other activities to cope with such problems. Where public services are involved, it is plausible that political acceptance of the associated tax burdens will be conditional on improved efficiency, effectiveness or quality of these services, and this is liable to

involve new technologies. Thus the ideal approach is one in which the needs for innovation are assessed within a more general assessment of the problems and opportunities of areas such as the above.

It would be as well to be very open-minded when it comes to formulating programmes. While some social needs are well-articulated and have substantial lobbies behind them, there may also be more pervasive needs which are poorly articulated simply because the opportunities for common application of new modes of service delivery are poorly understood. For instance, one idea proposed at the Brussels workshop is inspired by observation that there are a proliferating number of telephone-based advice and counselling services dealing with an apparently endless range of problems and limitless demand for their services. Numerous voluntary services have emerged alongside traditional office-based paramedical, consumer and citizen (largely paralegal) advice services, and commercial telephone information services (often on health topics). The proposal was that an R&D programme might concern the development of a framework to allow European citizens the opportunity to access - at zero or minimal cost, in any major language, using any telecommunications infrastructure, and using any major hardware platform (telephone, PC, Minitel, TV with Video-on-demand type facilities, etc.) - advice, counselling, information and emergency services on a wide and expanding range of social and personal problem areas, and provided by a diversity of suppliers thus allowing for citizens to exercise choice in the (frequent) situation of competing claims to authority.

This example is not being offered as being a particularly privileged area for service innovation. The point of citing it here is simply to emphasise that the scope for innovative programmes may well go beyond the areas of social need that are conventionally identified. It is our suspicion that there are numerous opportunities for the development of new services, requiring mixtures of social and technological innovation, and with the capacity to enhance Europe's quality of life and economic capabilities. Mechanisms need to be developed to improve the articulation of such possibilities, and to assess their contribution to the different objectives that lie behind R&D programmes. The recent European Social Policy Forum, for instance, strongly demonstrated that "social" NGOs would like to play a greater role in consultation concerning EC programmes, so there may well be opportunities to capture here.

6.5 Some Further Points

The development of KIBS, and the growing role of services in innovation networks, points to a set of developments which are changing the ways in which knowledge activities are being produced. Technological knowledge is being generated at new sites, in new division of labour, and the modes of transmitting this knowledge are similarly changing. Little is known of the implications of these changes more generally, despite some analysis of "Mode 2" R&D (Gibbons et al, and of the growth of the Second Knowledge Infrastructure (Bilderbeek & den Hertog). Questions arise as to whether the established governance structures of science and technology are responding adequately to these changes. These are the fundamental issues behind the specific analyses of services presented above.

Two other sets of issues arise in this context. The first relates to innovation policies, which are increasingly being seen as efforts to influence systems of innovation (rather than to promote specific firms or innovations). An example of this is the interest in Technology Foresight programmes, designed not to "pick winners" but to

share visions and build networks, thus promoting more co-ordinated and less risky action. In the UK Foresight programme there was a notable effort to build in services like retail and distribution, finance, transport and (to a more limited extent) entertainment, medical and education services. There were problems associated with mobilising key actors into some of these groups, indicative of service managers' tendency not to identify their activities with technological innovation. Yet when it comes to considering priority areas for European S&T in futures decades - problem fields such as those associated with ageing, security, etc. - the participation of relevant service organisations must be crucial. European programmes should thus seek both to turn to system-strengthening modes of operation, and explicitly incorporate services into these. The coming Framework Programme might constructively allocate some of its resources in this direction, in the awareness that R&D programmes might not be immediately defined by such actions, but that improving the institutional capability of making appropriate choices requires prior network-building.

On a possibly more contentious front, there are grounds for anticipating a growth in the strength and vociferousness of "neoLuddism". Fuelled both by social changes (social inequality, the emergence of a "Risk Society", etc.) and by a wide range of problem areas associated in people's minds with the use of S&T (environmental problems, health problems such as the "mad cow" issue, unemployment), groups sceptical of S&T development on a wide front are emerging. These groups reflect a more pervasive unease about the relations between society and technology, which may promote apathy or opposition to continuing S&T investment. There are many ways in which the relationship between technology and society might be addressed, but the formulation of R&D programmes is not least among these.

One step that might be taken here is to extend the constituencies and modes of consultation employed in the network-building processes referred to above. Methods like consensus conferences and scenario workshops could be used to give early warning of social unease and potential problems. Groups in regions and SMEs could be involved in generating their own visions of positive participation in the production and use of new technologies. These suggestions draw on a wider set of analyses than those stemming just from thinking about services, of course, and they may pose difficult institutional problems. But they might well be part and parcel of a set of transitional measures introduced in the process of reshaping European S&T policy.

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STEP-gruppen ble etablert i 1991 for å forsyne beslutningstakere med forskning knyttet til alle sider ved innovasjon og teknologisk endring, med særlig vekt på forholdet mellom innovasjon, økonomisk vekst og de samfunnsmessige omgivelser. Basis for gruppens arbeid er erkjennelsen av at utviklingen innen vitenskap og teknologi er fundamental for økonomisk vekst. Det gjenstår likevel mange uløste problemer omkring hvordan prosessen med vitenskapelig og teknologisk endring forløper, og hvordan denne prosessen får samfunnsmessige og økonomiske konsekvenser. Forståelse av denne prosessen er av stor betydning for utformingen og iverksettelsen av forsknings-, teknologi- og innovasjonspolitikken. Forskningen i STEP-gruppen er derfor sentrert omkring historiske, økonomiske, sosiologiske og organisatoriske spørsmål som er relevante for de brede feltene innovasjonspolitik og økonomisk vekst.

The STEP-group was established in 1991 to support policy-makers with research on all aspects of innovation and technological change, with particular emphasis on the relationships between innovation, economic growth and the social context. The basis of the group's work is the recognition that science, technology and innovation are fundamental to economic growth; yet there remain many unresolved problems about how the processes of scientific and technological change actually occur, and about how they have social and economic impacts. Resolving such problems is central to the formation and implementation of science, technology and innovation policy. The research of the STEP group centres on historical, economic, social and organisational issues relevant for broad fields of innovation policy and economic growth.