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Services in innovation - Innovation in services

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Preface

Services are myth-making stuff. The lanterns that have shed light on our economies have left services residing in the dark night of the economy; in a world of myths and legends: a residual world, a *tertium datum*, of the intangible and inexpressible. It is a world inhabited by shadows, by priests and servants, by hamburger-flippers and pizza delivery services, by hot-air selling consultants ... and scientists and professors. The world of night is a danger for the world of day, smothering it. Furthermore, the twilight zone is no longer clearly defined; the world of day is increasingly inhabited by creatures of darkness.

This report, together with two SI4S synthesis reports, Sundbo and Gallouj 1998a and Bilderbeek, den Hertog, Marklund and Miles 1998, sums up the main conclusions from a collaborative European research project on service innovation, involving a substantial research consortium in nine European countries. With the opportunities offered by the Targeted Socio-Economic Research programme under the EU Framework IV programme, it has been possible for the first time to organise a large trans-national network to analyse innovation and economic dynamics in service sectors and service sectors' roles in wider innovation and economic change. The project was launched in March 1996 and has involved a range of national and trans-national projects. The final projects were concluded by the end of 1998.

The starting point of the project Services in Innovation – Innovation in Services (SI4S) was the observation that there was a considerable gap between present efforts to understand innovation and other change processes, and ongoing structural changes in national economies. While service sectors, though widely disparate in their economic roles, account for about two-thirds of overall employment in European economies (and include the most dynamic sectors in terms of employment growth over the last decades), they have not being paid sufficient attention in the innovation literature. Similarly, there has been a significant under-focusing 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. Treating service sectors as supplier-dominated technology users has meant that 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.

Over the last few years, however, there has been a significant increase of interest in service innovation and industrial policies, both at a national level and at the level of the European Union. With the EC 1993 White Paper on Growth, competitiveness and employment, a focus was placed on inter-relations between economic activities, and the role of immaterial developments in knowledge and organisation; this implies a reassessment of the role of services in the processes underlying productivity, competitiveness and employment growth. Following up the White Paper, the Green Paper on innovation enumerated services as innovative but unrecognised sectors, and added that "the priority given to it in analyses and innovation policies is far from commensurate with [their] influence" on innovation and innovative performance. The Green Paper did not however make any attempt at developing a framework for innovation policies to encompass these influential sectors.

Since then there has been a rapidly growing interest in such issues, as evidenced at European level with the *Services of general economic interest* and *Putting services to work* communications from 1996 (and subsequent work), as well as with the information society initiatives.

As regards science, technology and innovation policies, the trend over the last decades has been a turn away from industry- and sector-based 'support' policies, and towards *framework-enhancing* policies aimed at amending the institutional system to comply better with the prerequisites for efficient innovation processes. Concomitant with a shift towards framework industry policies, there has been a push towards dissolution of traditional industry specific policies, with a strong emphasis of industry neutrality, or non-selectivity, of public industrial policies. A framework oriented and system based understanding for policy formulation raises fundamental questions about the feasibility of non-selectivity of such policies. It raises the need of a deep understanding of interrelations and dependencies across industries and

sectors, of systemic dimensions of innovation performance. There is ample evidence that the role of services in these interrelations is highly – and increasingly – significant.

As indicated, there are signs of ongoing shifts in policy and research attention. Our objective has been that work in the SI4S project should contribute to this change, by strengthening the basis both for our understanding of social and economic development in the present era, and for the formulation of future industrial and innovation policies at national and European level. Our hope is that we have succeeded in taking some steps in this direction and that we have succeeded in showing that the topic of the SI4S project is enticing as well as rewarding: The creatures of the shadow world also include Cinderellas and ugly ducklings. We hope that we have been able to shed some light on the world of night, showing that though the beasts out in the dark may be different species from the beasts of day, their basic biology is essentially the same.

We take this opportunity to express gratitude to the TSER programme and to the TSER staff at DGXII. We have appreciated the opportunity of meeting and discussing issues relevant to this and other TSER projects with researchers in other TSER projects, and with members of the DGXII staff. In particular, we have appreciated the collaboration with ‘our’ scientific officer in the TSER unit, Ronan O’Brien, over the last three years.

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Abstract

There has been a considerable gap between efforts to understand innovation and other change processes, and ongoing structural changes in national economies. The SI4S project has aimed at developing concepts, empirical evidence and proposals for practical action concerning the role of services in European innovation systems. The general objectives were

- to map, understand and analyse the changing role of services and service innovations as users, carriers, shapers and sources of innovations in European innovation systems,
- to design, formulate and integrate options for innovation and technology policies and business strategies that take into account the role of services in innovation and innovation in services.

The project has approached the issues from three perspectives:

- statistical description and analysis of services development at a macro level,
- studies of innovation and the shaping of innovation processes in services at both the macro and micro-level,
- studies of services in innovation services, i.e. the development of a specific group of services (KIBS) and especially their contribution to innovation processes in a range of service and manufacturing industries.

We list here the main conclusions that have been drawn from the SI4S project.

Service growth and innovation

There is *no simple, recurring pattern of growth of service sectors* across European economies. But we may identify underlying general aspects of the growth process. Service employment shows two opposing trends: new service activities and a generally increasing demand for producer-oriented services create new employment. On the other hand, rationalisation processes are leading to new labour-saving processes of service provision. Ongoing development of service sectors reveals the following three phenomena,

- a *reorganisation* of the division of labour between manufacturing and service sectors in national economies,

- the *internationalisation* of service activities, supported by the creation of a Single European Market and by deregulation in many service markets,
- the introduction of *technical progress*, mainly due to the widespread use of information and communication technologies.

Innovation is shaped by general characteristics of the competitive environment. This reinforces one dimension of *innovation as* essentially a *market phenomenon*, while leading towards a wider understanding of interactive innovation in European economies.

Understanding the challenges for industrial innovation policies in an integrated 'knowledge-intensive' economy, calls for an *understanding of innovation on service markets* and the role of service functions in systemic innovation.

A fundamental aspect of this understanding is the necessity of venturing *beyond technological innovation* approaches, to encompass the plurality of business strategies and functional characteristics across the industrial landscape.

Innovation in services

Innovation is widespread in services. Service firms and sectors are increasingly becoming the sites of deliberate attempts to innovate; to improve the cost efficiency and quality of service production and products and to develop new service concepts. This also reflects changes in the nature and structure of competition in various service markets.

A significant part of innovation patterns in services is 'soft', or *non-technological*, even when restricted to product and process innovations. Soft product innovations are frequent. However, for some categories of services, primarily information, technologies play an important role in shaping services; process innovations in particular are inclined to be more technologically oriented than process innovations.

Characteristics of service innovation still allow the use of the traditional taxonomy into product, process, organisational and market innovations. However, such *innovation attitudes* may be enriched by consideration of *modes of innovation*.

On the basis of a general model of service innovation, three categories of emerging innovation trajectories are identified; service professional and *professionalising trajectories, strategic management based trajectories* and *technological trajectories*.

The trends associated with these categories involves an increasing *formalisation of innovation* activities in service sectors, typically developing along either a service professional pattern or a pattern of organised strategic innovation.

Services in innovation

With the emergence of knowledge markets and distributed knowledge generation, *knowledge intensive services* appear as *bridging institutions* in national innovation systems. These service firms supplement and broaden the generative and distributive functions that have traditionally been the responsibility of public technological infrastructures, R&D institutions, advisory and extension services etc.

Rather than envisaging this interaction as flows of knowledge, a fundamental aspect of KIBS interaction is that it is an essentially bilateral learning process; a *co-production of capabilities*. As for their role in innovation, KIBS act as facilitators, carriers or sources of innovation.

KIBS also play an important role in the various knowledge conversion processes. It can even be concluded that KIBS play a *key role in transforming firms into learning organisations.*

This interaction with KIBS is not confined to the discrete/tangible, contractual, explicit/codified and non-human embodied forms of knowledge. On the contrary, the functioning and role of KIBS can only be understood if we include *process-oriented/intangible, non-contractual, tacit and human embodied forms of knowledge.*

Statistical evidence shows indeed that European economies' technological and organisational capacity is a function of its use of *communications and business services*.

KIBS have a symbiotic relationship with their clients. Through their activities they act as bridging institutions in innovation systems and contribute considerably to the

'knowledge distribution capacity' and learning capacity of innovation systems as a whole.

Services in innovation systems

Services has a *direct and immediate role* in localised innovation systems. An innovation system approach captures important features of systemic aspects of innovation in services.

However, service related 'specific' innovation systems in general appear to be only *weakly integrated* into wider innovation systems. In particular, the links between several service sectors and *public infrastructures of national innovation systems* are weakly developed.

A *new mode of knowledge production* is in the making, altering the structure of innovation systems. In the new system knowledge production is widely spread, and involves diverse contexts of application. Knowledge production is shaped by market interaction in a fundamental way.

This mode involves a *diversity* of new forms, new codification patterns, and bundling into other product markets of knowledge transmission or interaction, alongside the traditional modes of transmission/interaction.

Challenges for innovation policies

There is a need for *reconsidering* the role of industry oriented *innovation policies*. In particular, there is a need for a *broader approach to innovation*, and a stronger emphasis on economic interaction and complementarities.

With service functions as significant loci of learning and organisational flexibility in organisations, *learning and organisational capabilities* should be explicitly addressed in innovation policy formulation.

Weak links between some service sectors and technological infrastructures also reflect the *inappropriateness of* these *infrastructures* for the needs of service clients. With a weaker intra-industrial organisation, industrial support systems are almost non-existent in several service industries.

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. Service innovation centres would probably be the best way for the public sector to facilitate the growth of a European innovation system within the service sector.

A major impediment to service innovation is a lack of sufficient *management capability* to induce and carry through innovation processes in the single service firms and the lack of a learning system through which experiences in single firms could be transmitted to other firms to learn from.

KIBS are increasingly a key for industrial competitiveness. They raise an important innovation policy challenge - *policy objectives* should be more *open-ended and framework enabling* instead of being oriented towards specific technological or economic objectives.

Public policy should ensure the *distributive capacities of broader innovation systems*. Furthermore, a central objective should be to build up systematic *absorption capacities* in business firms. This is of particular importance for SMEs.

Ensuring *flexible interaction* of the distributed system of knowledge producers *with* the public system of *universities and other scientific institutions*, institutions of higher education and so on, to allow appropriate divisions of labour and incentives is an important issue.

Public agencies and public policy should play an important role as *market makers and mediators* on emerging knowledge markets.

Keywords: Economic development; KIBS; Innovation; Innovation policy; Innovation systems; Services

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Services in innovation - Innovation in services

Introduction

Economic and social development in the 30 years since the mid-1960s, the days of Galbraith's affluent neo-industrial society, when the secondary sectors, the engines of economic growth, were at the peak of political interest, but increasingly showed prospects of a different future, have considerably broadened our understanding of structural change and economic growth. In spite of the lack of a comprehensive consensus on what has driven these changes, the idea that we are living through a transition of industrialised economies into complex 'service-based' economies or knowledge-based economies is shared by all.

Today roughly 2/3 of employment of OECD countries is in the tertiary sectors. While the total OECD employment in wholesale and retail trade and hotels and restaurants was larger than the employment in manufacturing industries in 1990, employment in financial and business services (FIRB - finance, insurance, real estate and business services) is substantially larger than total employment in manufacturing of machinery and metal products, including car and IT industries. Employment in social and governmental services respectively corresponds to about 2/3 and 3/4 of the total manufacturing employment. Over a ten year period from the early 1980's to the early 1990's, manufacturing employment in the three large European economies of the UK, (West) Germany and France shrank by about 2,5 million to less than 20 million. During the same period the employment in financial and business services in these countries increased to more than 5,5 million, more than 2 million over the level in the early 1980's. Some illustrations:

- In the sectoral pattern of employment growth in OECD countries from 1970 to 1993: employment in real estate and business services; in consultancies, software development, engineering services, R&D contractors and marketing more than tripled in this period. Seven out of the ten fastest growing sectors over the 25 years are service sectors. The sectors with the largest decline in employment are primarily low- and medium-tech industries.
- These changes are reflected in changes in the composition of the labour force in OECD-countries. While overall manufacturing employment has diminished,

employment of high skilled white collar employees has increased; there is a strong 'upskilling' in manufacturing industries. The share of such occupations in employment growth in market services is also considerable; concomitant with the growth of advanced business services, the share of 'information' or 'knowledge' workers in the economy has risen.

- Expanding service sectors have become intensive and sophisticated users of information and communication technologies, thus shaping the development of these technologies.

These simple indicators and arguments suggest that ongoing changes in the structure of production systems and of inter-sectoral relations are significant and contribute widely to the shaping of contemporary economies and societies. This involves structural changes *within* service industries, in their *relations* to other sectors of the economies, and in the distribution of production and employment between service sectors: it also involves the emergence of *new* services. Services are increasingly becoming integral parts of techno-economic and innovation networks. Expanding service sectors implies that the growth capacities of national and regional economies will increasingly depend on the ability of service sectors to innovate and compete. Deregulation, or rather re-regulation, and the opening of service markets to international competition implies that the future welfare prospects of European economies will depend crucially on productivity growth in existing and emerging service industries. Demographic changes, in particular ageing, gives an additional strong impetus to the need for effective and efficient service industries.

These processes challenge our understanding of ongoing changes and raise the need for a better understanding of

- structural changes at an aggregate level,
- changes at industry- and firm-level, and
- the dynamics behind these changes.

This underscores the need to understand the unfolding dynamics and their consequences on at least two levels; at *policy level*, development is important both in terms of general welfare policy and as a prerequisite for relevant industrial policies, while the possibilities for business strategies are determined at the *business and industry level.*

Given this background, it is a paradox that until recently service sectors have been under-focused both in the *research attention* they have received and in terms of

industrial policy formulation, manufacturing still being implicitly regarded as the engine of economic growth. There is a need for a better understanding of the processes and relationships that underlie the aggregate changes we observe. More specifically, if we are to develop an understanding of what the challenges are for industrial innovation policies in a integrated 'knowledge-intensive' economy, there is need for understanding innovation on service markets and the role of service functions in systemic innovation.

These processes have been the focus of the SI4S project. More specifically the questions raised are;

- Is innovation relevant for service functions?
- What is the nature and characteristics of innovation in services and service-related innovation? To what extent are these distinguished from the accepted (manufacturing) modes of innovation?
- Does the concept of technological innovation as developed in innovation theory reflect these characteristics?
- Are service peculiarities relevant…
- in determining levels of innovation activities and
- in modulating patterns of innovation in services?
- How do services influence and shape innovation patterns in value chains?
- To what extent and how do services link to national and European innovation systems, in particular to technological infrastructures and traditional public instruments of innovation policies?
- Are the nature and characteristics of service and service-related innovation reflected in innovation policies? What are the challenges for policy formulation?

On Ghosts and Cinderellas - Issues and frameworks

The quest of the growth engine

Any perusal of the by now huge literature on innovation, economic growth and competitiveness leads to a very definite conclusion; the determinants of long run productivity growth and wealth creation are exclusively linked to technological innovation in manufacturing processes. This conclusion applies equally to 'high-theory' literatures on economic growth and gains from trade and 'appreciative theorising' in evolutionary economics (often termed neo-Schumpeterian) approaches, as to empirical survey based analysis of innovation. The tacit consensus thus is a confirmation of a general view that the 'engine of growth' lies in product and process innovations in the manufacturing industries, and that the decisive factor for national competitiveness in a globalised economy is the ability to create and utilise industrial and commercial opportunities arising from dynamic 'generic technologies'. As a corollary of this view, it follows that a large, if not the largest, share of modern industrialised economies is relegated to a position outside the wealth generating engine. During the 1980's this view condensed into a spectre, the spectre of de-industrialisation. The shedding of the labour force from manufacturing had a complementary counterpart; an uptake of labour in sectors of the economy where technological innovation was at best marginal, or even absent, and which had small externality-generating and knock-on effects on other parts of the economy.

These views have been substantially reflected in innovation and technology policies in European countries, a reflection that has contributed significantly to differences in the integration of manufacturing and service sectors in technological infrastructures. Closely linked with the de-industrialisation thesis of the 1980's, public policies' focus on strategic technologies had a strong hardware and technology push orientation, especially evident in the highlighting of flexible production, to flexible manufacturing systems. With ideas of 'just-in-time', kanban, etc., production, notably *manufacturing* production, was almost exclusively talked of in terms of the installed base of industrial robots, of CNC machines etc.

In spite of the 'high tech' flavour of these views, the substantivist view of manufacturing as the growth engine has a long history, tracing its origins back to ideas that were an integral part of the classical political economy of the 18th and 19th century. A dominant thread in this heritage begins from the need of political economy to delineate the wealth-(re-)producing economic system, i.e., from the analytical device of distinguishing between productive and unproductive activities in a framework of a naturalist, or substance, notion of wealth. In spite of the 'relativising' of the notion of wealth implied by economic thinking following this period, the substance notion of wealth has proven to be an enduring heritage.

With the immateriality of services and hence their inability to contribute to long run welfare generation, manufacturing is what matters. Sustained productivity growth is not possible in non-material, technology-poor activities; the bottom line is we cannot make a living out of cutting each other's hair. In this sense, services are unproductive and superfluous; service consumption is a luxury. Not only is manufacturing production what matters, so is manufacturing (material) consumption. These characteristics reflect several of the criteria used in classical political economy to delineate productive from unproductive activities, in order to identify the system of economic circulation and accumulation. The basic aspect of this delineation is the concomitance of production and consumption: services as unproductive activity leaves no traces. This emphasis on the ephemeral character of services is a direct consequence of the substance view of productivity, and wealth.

Uncritical classification of 'services' as unproductive, or in its modern versions as productivity and innovation laggards, has been confounded with the view of the residual of services as a positive category, sharing common defining characteristics. A delineation of services usually starts with services' negative characteristics, telling us what services are not. It is perhaps a surprise, though, that these characterisations often hark back to the classical discourse, using the relation to materiality as the defining feature; service activities are those which do not produce or modify physical goods. The 'best' suggestion of a definition is perhaps the *Economist*'s characterisation of service products as "anything sold in trade that could not be dropped on your foot", another of the journal's catchy maxims, as a sardonic comment on the fruitless efforts to determine the indeterminate.

These views are inconsistent as a basis for analytical and political reasoning about economic change and socio-economic policies for three reasons. First this 'modern' reflection fails to take on board the impact of the classically based argument. The analytical device of distinguishing productive and unproductive labour did not distinguish services, production of 'non-goods', from production of (material) goods. The unproductive service concept was much more specific and limited. Secondly, interpretation of productive or productivity has moved away from this basis. From being an analytical device in a specific context, its more common sense use has shifted to more normative connotations. Lastly, these views fail to take account of development of economic thought from the classical period. Towards the end of the last century the productive/unproductive dichotomy lost its potency due to the changed understanding of the economy. With the new economics, the classical notion is unnecessary; Alfred Marshall could declare that *all* labour except that "which failed to promote the aim towards which it was directed" was productive, as a guide to the production efficiency of economic activities.

Distinguishing material from immaterial goods, as services, is irrelevant from the perspective of economic development. This does not deny, however, that there are other distinguishing features between the two categories, but the distinction must now be made on the basis of their properties as economic goods; on their transferability, or vendibility, and not on their materiality. Unless one generalises the market concept, this evidently restricts focus to services provided through open market transactions.

The meaning of services

Noting the strong heterogeneities of the mixed bag of service activities, it is no surprise that no general consensus as to what constitutes services has emerged. We venture the claim that this is a consequence of the widely disparate character of individual services; it is unfeasible to group these activities together into one consistent category.

The term ‘service’ itself has many connotations, both in terms of its meaning[1], and because of the human ability to operate simultaneous homonyms, without effort. At the same time as we deride services, such as ‘hamburger flipping’ for not participating in social welfare generation, we are anxious to identify our professional functions as a service to our customers. The term is also reflected in firm-level statements of business and marketing strategies. Emphasising the service component of provision of material products, including identifying the product with the services it will render to the customer, is evidently seen as significant to competitive position in a wide range of manufacturing industries. But this emphasis on ‘services rendered’ also has an internal function, in creating an internal work environment; it reflects the producer’s apprehension of her own ‘business’ - and of her own social function. This implies a need for caution when approaching management literatures on services, as these often reflect such apprehensions. Equating service content as anything beyond the ‘bare’ physical necessity or modification involved in the product involves a fictitious baseline, the idea of a completely ‘service-free’ product is meaningless.

The futility of pursuing any precise definition is evident. What we include as service functions will, reflecting the indeterminacy, not be defined in a precise way, but will correspond broadly to what are usually regarded as service sectors. It is nevertheless true that some products with a high ‘service content’ in some sense have properties that pose challenges to conceptualisations of service markets, challenges that are relevant to our prime focus in this report. The constitution of service markets will form one significant determinant for the mechanisms of variety generation and selection underlying the link between innovative behaviour and its ‘reshuffling’ effects on the economic agents; *viz.*, the service providers and users.

Immateriality, or intangibility, and non-storability of services or service products cannot form the basis for an economic classification of services. However, two features, related to intangibility and often implied in these discussions, come closer to identifying the *economic* characteristics of service transactions:

- the ephemerality; *i.e.*, the fleeting existence, of service products, and
- intense user/producer interaction, with a strong element of customisation.

[1] The Webster’s dictionary gives close to 20 different meanings of the word, several of which are relevant for interpreting various strands of the service literatures.

Together they are frequently used to emphasise the coterminality of production and consumption as a characteristic aspect of many services. The ephemerality condition, and the implied non-storability, would seem to involve again the materiality condition in disguise. However, here the point is that this quality affects market characteristics; futures is the only mode of storing products. Client intensity is not a qualitative distinction between service production and manufacturing, even though there may be differences of degree between individual activities. For some types of services the combination of the two may imply 'true' co-production is distinctive, but it is not clear from the literature how large this class is.

Innovation in services

Myths about services are abundant. One of the most prominent of these is the characterisation of services as productivity laggards; their low productivity growth will become a drag on overall productivity growth. Furthermore service sectors have low capital intensities, and low propensities of capital embodied productivity growth. The high labour intensity is further exacerbated by another myth; the service dominated economy is one with a dichotomous labour market, with a large number of unskilled 'shoe shiners and hamburger flippers' in cost disease inflicted services, and a much smaller dynamic labour market of high skilled scientists, engineers etc. integrated with the highly productive manufacturing sectors.

Such myths also imply an innovation theory, or myth, of services. To the extent that innovation in services exists at all, it is a marginal phenomenon, innovation in services being incremental, mostly demand driven, and where changes are superfluous. Technological innovation is dominated by the adoption of technologies developed elsewhere; it is not only supplier dominated, it is supplier driven.

The basic conclusion of this paper and the SI4S exercise is that these characterisations of services are misguided, for three interrelated reasons;

- innovation is ubiquitous in services also, but a focus on innovation in services raises a series of issues related to our present conceptualisations of innovation that have a validity beyond a consideration of service sectors,
- a sector frame on innovation studies, and in particular a quest for a single source or driver of economic growth, misses fundamental points about the constitution

of economic *systems*. A system perspective is of fundamental importance to understand both innovation and services,

- the role of various service functions in shaping and modulating innovation capabilities in client and supplier sectors is an important part of this systemic perspective.

Innovation blue prints

As will be argued in the following sections of this paper, a richer understanding of the concept of innovation and of innovation processes has been afforded by the SI4S project. A fundamental aspect of this understanding is the necessity of venturing beyond the view of 'innovation as substantive events' that underlies technological innovation approaches. The immediate consequence of a richer concept of innovation is a less clear cut and more diffuse view of innovation, a better understanding of service markets and production and a strengthening of the basic character of innovation as *market phenomena*. Innovation is fundamentally shaped by market opportunities and challenges, as perceived by the innovator, and must be regarded as a deliberate response by the innovator to these opportunities or challenges.

This view of innovation places it on par with a huge set of market strategies and actions that may be undertaken or implemented by the innovating firm. This set, which includes strategies as varied as 'brand naming' and other marketing strategies, product and price differentiation strategies, formation of horizontal and vertical alliances and networks, employment of new categories of personnel, organisational and management issues etc., offers a continuum of strategies to the innovator. The problem facing the innovator at all times is to design and update an optimal composite of such actions and strategies, given the perceived characteristics of the markets in which the innovator operates. Such strategies, when implemented with the intention of changing the innovating firm's appearance on the market(s), are innovative in the Schumpeterian sense of being 'new ways of doing things,' – new to the firm at least. In this sense, we identify innovations with the implementation of deliberate decisions made - and actions undertaken – to improve firm performance, exploit perceived market opportunities and otherwise respond to challenges in the business environment.

There are two other more or less implicit dimensions to innovation in the sense the concept is used in the innovation literatures. Innovations surpass a minimal 'level of novelty' and they are effectively 'blue-prints'. The canonical formulation of a minimum threshold of novelty occurs in the Oslo Manual/CIS requirement for changes (to products and processes) to be 'significant' improvements of product and process performance or other characteristics. Technological innovations in the Oslo Manual sense are concerned with the characteristics of products and processes themselves, requiring "an objective improvement in the performance," of products or " in the way they are produced or delivered." This substantive, or objective, notion of innovations, as contrasted to a process view of innovation, implies what we may term a 'blue print' approach to innovations. Innovations are limited objects that may be described by demarcated changes in objective performance characteristics, or the setting up of new performance characteristics.

The point here is not that this approach is wrong or misses the main points of innovation. In fact there is a very good reason for these criteria; intentionality of decision making, degree of novelty in performance and of objectivity of product and process innovations. Together they imply concise requirements for information signals to competitors, customers and others. Information about innovations is thus capable of being transmitted between agents and hence a blue print may be adopted by competitors; i.e. the innovation is imitated, the information in the blue print may change demand conditions on the market or in the industry and the customers' own innovative performance, or the blue print may be adopted by an agent in another industry or market. In short, blue print innovations are strong vehicles for externality generation; the existence of the blue print pattern on the market changes the market environment where ultimately successful blue prints are described as diffusing over the market as they are adopted by competitors or customers. But note that these blue print externalities are just a subset of the externalities that may be generated by innovating firms.

This blue print approach is particularly well adapted to markets where there are objective product and process concepts, especially to markets where products are material and characterised by a discrete set of market relevant performance characteristics. As performance characteristics become more diffuse, and

intangibility of products increases, this blue print model becomes less clear cut. For information or 'knowledge' (intense) products, where the product to a large extent is constituted through the information it includes and where 'objective performance characteristics' are closely related to reliability, adaptability (for the client) and otherwise quality of the supplied information, a blue print approach quickly becomes less useful. It is not that there are no product concepts available on the market in question, but the characteristics of the product concepts themselves are unclear.[2]

An illustrative example may be the 'ultimate' information products such as consultancy or R&D products. A frequent response for firms in these industries is to reply that no innovations have been undertaken in the firms, as the product delivered is essentially the same product produced by the consultant in more or less the same way, or that all deliveries constitute innovations through the adaptation to client specificities. The point to note about these industries is that the production process is not a re-production; there is a high degree of customisation, seemingly akin to product differentiation. Hence, the customisation seems to favour the no innovation stance as the basic. However, the customisation is not a differentiation on the basis of finite or discretely designed alternatives, nor is it merely 'aesthetic.' In an essential way, this customisation involve creative elements and problem solving, which may favour the latter stance. Customisation in this form involves co-production.

From these considerations we can draw the conclusion that the content of the innovation concept must be adapted to the intentions of the innovation analyst, in addition to the characteristics of the object of study. If the intention is to analyse the development of firms and specific markets, a wide definition is needed. An industry level analysis with a focus on the structural characteristics of the industry in question may allow for a more restricted innovation concept, while an analysis focused on economy-wide growth and development may restrict the concept even further by considering the range of the diffusion or adaptation process.

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[2] Even more so in market services as has been the focus of the SI4S project, it should come as no surprise that firms generally have a well-developed conception of its product, tied up as it is with the regard for 'what business the firm is in'.

Characteristics of service markets and production

It has been noted that various service products and markets may be characterised by several features stemming from client intensity, or from product intangibility (see Hauknes 1996). To the extent that these features, or 'peculiarities' of services, are relevant descriptions of services, they will consequences for the economic properties of the related service products, namely, for their exchange properties. Denoting these features as 'peculiarities' distinguishes them from a perceived normal state of affairs, the normality evidently being the antonym of the described characteristics.

Two aspects are shared by several of these 'peculiarities;' the intangible, often implying information intensive, character of many services, and the intensity of the relation between producer and user, or coterminality/cospatiality conditions. We note immediately that several of these peculiarities refer back to four aspects of service products and transactions; materiality, economic exchange properties, ephemerality and intensity of user-producer linkages. In particular, there seem to be three main characteristics that emanate from a list of peculiarities:

- an information contingency leading to 'peculiar' exchange properties and to strong spillover effects, or externalities,
- a related weaker institutional framework for enforcing property rights as rights to use,
- a strong degree of non-representativity of consumer utilities; with consumer utilities strongly dependent on idiosyncratic consumer characteristics, the lack of 'representative' behaviour creates 'peculiar' market characteristics.

If characteristics like these are relevant for activities within the tertiary sectors of the economy, they will evidently have consequences for

- the economic character and market structures of service products and
- the conditions for implementing changes in service industries.

and the way we conceptualise these structures and changes. Analysing more highly standardised mass services allows the possibility of considering the commodity characters of these services, with quite general exchange properties, whereas highly customised services could in principle participate in barter trade but are impossible to characterise as commodities. Innovation is shaped by the general characteristics of the competitive environment. To the extent that these features are general structural and functional characteristics of service markets, we must thus expect that they will

be reflected in general innovation patterns. With a less clear cut decomposition of service production into technological and market dimensions, we may attempt to approach a taxonomy of services through their functional content.

Attempting to classify services

The best-known attempt to classify services for analysis was made by Browning and Singelmann (see f.i. Singelmann 1978). Their typology combines a functional and a market/consumer based classification, and distinguishes between distributive, producer, social (or collective), and personal (or consumer) services. However, their classification was not developed with concern for the analysis of innovation in services. A distinction between consumer and producer services is evidently important for analysis of innovation processes. The Browning-Singelmann approach is not adapted to these tasks.

The general relationship between innovation and service sector industries is complex, reflecting the very diverse character of the sector. In order to get a better grasp of this, it is necessary to develop classifications of service sector activities along several dimensions. A basic distinction is between services that produce final outputs for the consumers sector, and services that provide intermediate or capital inputs for other production sectors. Against this background, services have a number of potential functional forms, which we can distinguish according to aspects of the knowledge-bases involved. These characteristics may be used as a dimension for classification.

- Firstly, there are services which use manufactured technologies and capital goods intensively; such services include distribution and financial services, and to some extent repair and maintenance services. (A major source of capital intensity in some services is buildings and fixtures which we can exclude here.) Such intensive *capital-using services* include two further important sub-groups. *Computation-intensive services*, especially financial services, should be distinguished from a group of *infrastructure intensive* services; as sea, air and land transport, and telecommunications. But other service sectors also increasingly involve more or less specialised advanced technologies; in particular information technologies - entertainment is an obvious example here.
- Secondly, there are services based on the creation and perceptive use of *specialised technological and functional capabilities*: these include various forms of business consultancy and R&D services, industrial design, engineering consultancy, software and systems development, as well as emerging

environmental services and so on. In some areas, such perception-intensive activities are also computation-intensive in terms of the processes through which they generate results. If we focus on the nature of the service rather than its object, maintenance and repair services, as well as facilities management may be placed here. Depending on the nature of the underlying competencies and 'knowledge bases' some of these service industries have been extensively regulated through professional standards and requirements.

- Thirdly, there are services based on the application of *codified professional skills* and competencies; these include legal services, accountancy, and so on. In these services there is often a strong role to be played for professional organisations and certification.
- Finally, there are services based on *tacit skills* - these include human-centred services such as hairdressing, restaurants, fashion design, cleaning services and so on. Entry into these services may be regulated, formally, as through proven skills requirements or informally, within the industry or by public agencies, or it may be unregulated.

Characteristic variations in the scales of operation of these services vary between these categories. Economies and diseconomies of scale depend on a variety of factors, where the factor biases described above play a considerable role:

- *Economies of scale:* The development of increasingly capital-intensive services means that in a number of fields economies of scale are apparent. This appears to be particularly marked in financial services and transport. Economies of scale are also apparent in technology-intensive parts of public services, particularly health care. Regulatory issues have in addition played a significant role in the shaping and development of economies of scale, as well as of the attainability of latent scale economies. The deregulation of telecommunications and financial services has clearly had an effect on economies of scale, as well as divestiture of provision of rail infrastructures from provision of railroad transport in several countries. While scale economies are less prominent in capability and skill based services (economies of scope is probably a more apt concept in these services), it is evident that there are scale economies in some tacit skill based services, such as hotels, catering and retail trade. These scale economies are probably to a larger extent economies in marketing and in management of factor inputs. A second suggested characteristic of scale intensive tacit skill based services is that intra-firm repositories of knowledge are primarily organisational, located in systems, manuals, codified routines etc., where skills of individual employees have been based on learning by doing.
- *Niche opportunities and changes:* Scale economies often give rise to and coexist with new niche functions; this has also occurred in service sector industries. The traditional mode is well known from manufacturing, with mass production being supplemented with product differentiation or market segmentation trends. Exploitation of scale economies has led to a technical division of labour led specialisation in several service industries, to the emergence of supplier markets of specialised services or to market opportunities for derived services. However it may also work the other way; increasing demand for specialised skill and competency intensive services creates niche opportunities in relevant service

industries and functions, side by side with scale-intensive services based on system competencies.

- *Economies of scope:* Economies of scope arise where assets and skills can be shared among production processes producing several service products; the basic idea is that there is a form of spillover, so that acquiring an asset or a skill in one area means that the firm simultaneously acquires a direct or complementary advantage in some other field. Emergence of 'full-service' business consultancy may afford an example, as well as expanding product portfolios of temporary employment services.
- *Coping with complexity:* One of the main impacts of high-performance IT equipment and software in services is that it enables some key service activities to engage in much more complex operations, and to extend the range of their activities.

It should be noted that the above factors of scale, scope and complexity mean that activity divisions become much less clear. For example, in the travel business, the processes of ticketing, managing accommodation, car rental, and so on are increasingly integrated, and it is no longer clear what the notion of 'core business' means in such fields. This has led to rapid changes in company strategy, with very unclear consequences: for example the Scandinavian airline SAS first tried a strategy based on the integration of a wide range of services (the 'partner' concept), and then moved back to a focus on air travel, with the sale of the related activities. In other service areas, particularly financial services, there has been such rapid entry into a range of areas that it is now somewhat difficult to distinguish between banks, insurance companies, mortgage providers, and stockbrokers. But this has also meant that manufacturing firms - such as automobile manufacturers - enter the sector via the supply of financial services linked to purchases of cars.

Miles has introduced further dimensions into a classification scheme of service activities (see Miles 1998a). This scheme cross-classifies branches of the services sector in terms of two dimensions. One axis indicates the client-intensity of the activity, broadly distinguishing between high, medium and low client-intensity. The second axis is one that is easy to relate to some major innovation trajectories. It reflects the different production processes - transforming the state of *physical objects*, *people* or *codified information* - they may centre on.

- *Physical services* primarily maintain (preserve through time) or transport (relocate through space) facilities, goods or people. Retail and wholesale trades combine distribution (the physical storage and movement of products) with exchange (transfer of ownership, largely an information function). Domestic

service may well include some elements of human services, when they involve personal care as well as cleaning of households. These include both producer and consumer services.

- *Human or person-centred services* span social and community services (health, education and welfare) which set out to develop and maintain cognitive abilities and social and physical well-being, together with a number of private consumer services which tend to be oriented more to personal appearance (hairdressers, etc.) or to providing various 'home comforts' as commodities (hotels, catering, and illicit and largely unrecorded services such as prostitution). Many of these services, it will be apparent, are state-provided.
- *Information services* span three types of service activity, whose historical boundaries are becoming blurred. *First* are the mass media, mainly distributing standardised data on a large scale (cinemas, broadcasting, etc.) *Second* are organisations distributing large volumes of non-standard information to specific recipients (telecommunications, and those financial industries who circulate symbolic material such as property entitlements). *Third* are knowledge services that produce and interpret specialised information (some financial services such as accountancy firms, advertising, marketing and consultancy companies, architectural, engineering and R&D services). They resemble person-centred services in that the information which they handle is often very client-specific, and they rely also on considerable professional expertise. These are generally producer services.

Most definitions of service sector activities, as we have noted above, begin with the idea of an immaterial product. In some people's minds this extends to the idea that service activities do not involve significant technology inputs; the then British finance minister, Nigel Lawson, argued as late as 1988 that future employment growth would be mainly in the service sector, and that this meant that "new jobs will be not so much low-tech as no-tech". This is a serious mistake; as we have argued above, many service sector jobs are highly capital-intensive, which in turn tends to mean technology-intensive.

The three broad subsets of physical and human- and information-oriented services sector are all likely to make much use of emerging IT systems, from transport telematics to medical informatics, from distance learning to interactive television. The three-way classification of services according to their orientation, key functional capabilities and client specificity suggests, however, that the context of innovation and hence innovation patterns will show considerable variety. Scale intensive services, with significant back office functions or extended delivery systems, make extensive and systematic use of IT in product production and delivery, whether in a information transaction framework, or more widely in a logistics and operations

analytic framework. In services that are based more on application of functional capabilities, a larger role may be played by ‘modulisation’ and project and capability co-ordination. In skill- and capability intensive information oriented services, a high client specificity may lead to a ‘consultative’ mode of relation between supplier and client which in turn leads to a functional innovation dynamics, generated so to speak at the interface between the two. In tacit skill based services, a larger role may be played by capital embodied productivity change.

In need of a wider innovation concept

In the SI4S project we have chosen to approach innovation from a fairly wide ranging perspective, to avoid undue limitations that could disallow a more considerate analytic specification to be implemented later on. This wide ranging style incurs somewhat of an anthropological approach, based on the firm’s own concept of their business against a background of the analytical concepts of innovation, products and processes. In the survey, see primarily the Work Package 3-4 synthesis, Sundbo and Gallouj 1998a, we attempted to implement this wider perspective on innovation by avoiding the use of ‘innovation’, and basing the survey on respondents’ own concepts of products and processes of producing these products. To describe innovation in a neutral way with the intention of avoiding self-censoring by respondents, innovations where defined as the implementation of decisions and actions taken by the firm that involved *significant changes* in the firm’s products, production methods, internal organisation and external relations.

This corresponds broadly to a simplification of a layered approach to describing fields or loci of innovation, cf. table 1, developed as part of the SI4S project. By describing innovation processes in terms of a multi-layered structural model of the firm, we may identify five broad categories of innovation and innovation capabilities. As is seen from the table, the taxonomy is based on a layered ‘value chain’ approach to a firm, consisting of integrated production and information flows. The first two layers concern production flows, while the rest deal with the different aspects of information flows and the integration between these and production flows. As such, they are more directly concerned, than the first two layers, with strategic management issues and the design of firm intelligence.

The first two layers of product and process innovations are what would correspond broadly to the Oslo Manual description of technological product and process innovations. The third level includes issues such as process innovations in supporting, or ancillary, functions as well as organisational changes related to these and to the implementation of product and process innovations. The fourth level concerns issues such as the implementation of new principles for the organisation of the firm, processes that may involve things like business process re-engineering, the introduction of concurrent engineering, quality assurance methodologies etc. Both the nature of innovation within each layer and the interaction between the layers would be expected to vary according to the characteristics of the innovator's activity.

Systemic innovation

As the outline in the preceding section makes clear, innovation performance by any individual firm is dependent on a multitude of information sources in the firm's environment and the linking of these to internal repositories of competencies. In a natural way this paves the way for a system's dependence on innovation. The interfirm divisions of labour evident in any economic system points directly to the crucial role of user-producer links, reinforcing the market dimensions of innovation. The institutionally structured environment of a firm or of a group of related firms is what has been denoted the system of innovation of the firm(s).

Table 1: Five layers or fields of innovation. Adapted from Hales 1998

1	**Product characteristics** *(product innovation)*
Innovation locus	Capabilities and competencies involved in the design and production of products
2	**Production and distribution process capability** *(process innovation)*
Innovation locus	Capabilities and competencies involved in the design and operation of production and distribution processes
3	**Administration process capability** *(organisational innovation)*
Innovation locus	Capabilities and competencies involved in the design and operation of information and co-ordinating processes
4	**Innovative business capabilities** *(structural innovation)*
Innovation locus	Capabilities and competencies involved in strategic and knowledge management and competitive transformation of firms
5	**Relations management** *('market' innovation)*
Innovation locus	Business intelligence and market research

A constitutive aspect of this system is information flows; successful innovation is dependent on searches for, and transfer and interpretation of information on demand characteristics, on competitors' actions and innovations, on applicability of externally developed information and knowledge on functional aspects of the business, or opportunities and challenges offered by such information, on wider social trends, and how they may affect future demand patterns, etc. A fundamental starting point for analysing innovation at a level beyond an individual firm, is that an institutionally structured environment of firms is shaped by multi-functional and multi-institutional complementarities; innovation systems are a conceptual bridge between evolving 'technical' divisions of labour and innovation (Hauknes 1998).

Modulation of innovation capabilities through service functions

This approach of complementary innovation is a basic ingredient in the Lundvall notion of innovation systems. This together with the multi-functional description of a firm that underlies Table 1 above, illustrates that the environment of a firm relevant for formation of innovation capabilities is complex. An innovation system includes a varied set of firms and institutions, beyond customers, suppliers and competitors. The dynamics of the relations between the various institutions may vary considerably between innovation systems, and they may change over time as consequence of innovation and structural changes. With a manufacturing bias, we have been

accustomed to think in terms of technological innovation, emphasising certain modes of relations with these different institutions and functions. More specifically, services have played a rather muted part in these dynamics.

Two trends have emerged rather forcefully lately, and which have been prominent in the SI4S project. F. Gallouj (Gallouj 1998a) describes the frequent reversal of relationships between manufacturing and service functions in innovation as the 'revenge of the [incorporeal] world of night' on the 'corporeal' world of day. Even with a restriction to technologically oriented innovation systems, it has been evidenced in several areas that service activities may generate new technological systems or change existing ones. This is particularly evident in service activities where information transaction plays a significant part. Evident examples are ATM and EFTPOS system technologies, but the same is also true of distributive and trade services, in for example, logistics, and the emerging system of use, generation and supply of geographical information. In cases like these, significant technology users play a dominant role in the evolution of the technological systems.

One of the most characteristic developments in recent years in European countries is the emergence of suppliers of and markets for complex information or knowledge products with a more direct relationship to partners' innovation capabilities. The emergence of knowledge intensive services and the institutionalisation of knowledge markets in industrialised countries is demonstrated by the extensive growth of relevant industrial categories in employment size, employment structure and value added (see below). With reference to the resources underlying the five layer typology of innovation, these relations and innovation capabilities apply not just to functionalities of products and processes or their deliveries, but also to organisation, management and co-ordination of activities, to the search for and generation and interpretation of external repositories of information, to strategy formulation and implementation and to market relations and alliance formation. The mode of interaction between suppliers of these services and their clients implies that the relationship mediated through such markets must be described in terms of variant typologies of innovation processes and links (Gallouj 1998b, see also Hales 1998).

Taken together these points highlight the need for a much more integrated and systemic analysis of innovation in services and of services' interaction with

innovation performance and capability formation in other sectors. There is no doubt about the impact of these developments on client firm performance. Both through case studies (for an overview see Bilderbeek, den Hertog, Marklund and Miles 1998), and econometric analysis we can show that interaction with knowledge intensive services has a considerable impact on firm performance and sectoral productivity.

Innovation – Markets and interaction

These macro-trends are broad patterns and subject to considerable diversity. However, a general feature underlying these trends is an enhanced awareness and the increased effort of a large number of service firms and industries to find new ways of interacting with their customers and to adapt to what is perceived as a rapidly changing business environment.

We have observed and mapped considerable efforts towards these ends at firm-level in a wide cross-section of service industries. There is now evidence that the service firms and sectors are increasingly becoming the sites of deliberate attempts to innovate; to improve the cost efficiency and quality of service production and products and to develop new service concepts.

There is no uniform pattern across sectors and between European countries in these developments; the trends within and between service industries vary between sectors and between countries. However, it has emerged rather clearly that there are two general characteristics behind many of these developments;

- changes in the nature and structure of competition in various service markets,
- an interactive process based on opportunities created through enhanced use and development of microelectronics, information and communication technologies.

These highly intertwined characteristics give a strong impetus to service firms to adapt to these changes and to introduce new modes of operation in their business - in short, to innovate.

Now these trends are not specific to service industries for they also apply to many manufacturing industries. The systemic and interactive dimensions of innovation place increasing emphasis on the distributive powers of the national innovation

system, as well as on its absorption or reception capabilities. More intense competitive environments of firms leads to increasing demand for capturing, processing and transforming specialised capability-enhancing information and competencies. These processes lead to the emergence of 'knowledge' markets, allowing individual firms access to the competencies and capabilities of specialised business service firms (Antonelli 1998a, 1998b). These 'knowledge intensive' business service suppliers act as bridges or converters between external and internal repositories of knowledge, interfacing between sources of information and codified knowledge external to the relation between the supplier and client, the supplier's competencies and capabilities in utilising these, and the client's localised competencies.

It is immediately clear that these knowledge markets support a variety of forms of relations between suppliers and clients. In most cases the relations will be extended over time; there is a strong element of interactive co-development between the two partners in the transaction. The interactive mode implies that the relation may more aptly be termed a relation of co-production of the service product, where in general there is a co-evolution of the two partners' competencies. This aspect of co-evolving competencies in the relations between these specialised 'knowledge' supplier firms suggests new forms of innovation, innovations that emerge at the interface between the supplier and client as a consequence of the mutual interaction of competencies, of bilateral learning. We will describe these forms of innovation in more detail below.

Patterns of service growth

There is no general pattern of growth of service sectors across the European economies. Growth in service sectors is not homogenous. However, groups of declining, stagnant and growing services can be identified for all EU countries, usually comprising a similar range of industries. The overall impact of service sector dynamics on the economy depends upon the relative weight of national service sector configurations. But in all the countries which have been analysed, business (or producer oriented) services seem to be the most rapidly growing subsectors.

Service employment shows two opposing trends: new service activities and a generally increasing demand for producer oriented services create new employment.

On the other hand, rationalisation processes are leading to new labour-saving processes of service provision. Nevertheless, employment trends in services are still generally positive. In some service industries, and in some countries, employment develops in proportion with changes in service output, while in others its expansion exceeds growth of output or remains behind it.

Ongoing development of service sectors reflects three phenomena:

- a reorganisation of the division of labour between manufacturing and service sectors in national economies,
- the internationalisation of service activities, supported by the creation of a Single European Market and by deregulation in many service markets,
- the introduction of technical progress, mainly due to the widespread use of information and communication technologies.

Shadows of the Night - Innovation in services

It is a paradox that services have been largely overlooked in economic, industrial and innovation research, that they have been regarded as comprising a residual of activities with marginal dynamism and autonomous existence. It is a paradox since our private and professional lives are embedded in a pool of these services; in a sense the diversity of services we encounter is what makes economic life possible, where we are exposed to gradual and abrupt changes in the functionalities and complementarities of these services. It is even more paradoxical that those who promulgate this view of services as innovation laggards are dominantly themselves engaged in service activities.

Some classes of service innovations

Trade: Formats and formulae in retailing, automated inventory

Transport and logistics: Containerisation, third party logistics, aircraft & system

Financial services: Derivatives, share funds, database management, internet banking

Consultancy services: Intangible asset valuation, rapid design and prototyping, environmental impact analysis

Telecom services: Cellular telephony systems, broad band ISDN

Broadcasting services: Frequency modulation, pay-per-view

Health services: Prophylactic medication, screening techniques

Other services: Surveillance systems, strategic games, pattern recognition

Nevertheless, such views are understandable as 'heroic' generalising assumptions. First, over the last 150 years we have lived through an era where manufacturing industrialisation and innovation has been an 'outstanding fact of economic history." But given that service sectors account for roughly 2/3 of employment and value added in most European economies, this generalisation is tantamount to a rather pessimistic view of the future of these economies. Secondly, our present understanding of innovation is primarily an understanding of 'manufacturing' innovation. The diversity of service activities in modern economies shows that 'service sectors' or activities constitute a *residual* of economic activities, defying most existing generalisations of economic and innovation characteristics; 'hamburger

flipping' and shop assistance live side by side with management consultancy and cancer treatment in this residual. However, it is not difficult to acknowledge several complexes of significant innovations in various services sectors, some examples of which are noted above. Our aim here is not to understand the specifics of such cases, but to outline a framework for understanding the dominant aspects of such innovations.

Delimiting innovation in services

Innovation is widespread in services, as it is in manufacturing. However, it is evidenced through the SI4S project that the concepts of innovation as developed on the basis of analyses of manufacturing industries are not directly applicable to service sectors. It has become abundantly clear that a restricted technological product and process innovation approach must be extended to cover the interactive user-producer relations present in many service markets (cf. Sundbo and Gallouj 1998b). As suggested in the previous chapter, this is related to a lesser constitutive role of ideal production processes and products in giving structure to 'service intensive' industries, than in manufacturing (commodity) production. In 'servicing' relations the product is not perfectly formatted, or precisely determined; client interaction involves a co-producing relation where 'servicing' aspects are strong, and each transaction is in a sense unique, and adapted to client-specific circumstances. However, it should be evident that the degree to which this is the case varies; these relations are not solely located in the transactions of 'service' products.

In contrast to the 'mass production' picture, the 'service' picture does not allow similar simplifying concepts of innovation processes as the blue print approach of the Oslo Manual to technological product and process (TPP) innovations. Broadly speaking, we may follow Schumpeter in identifying the act of innovation as the introduction of "any 'doing things differently' in the realm of economic life", or the carrying out of new combinations of factors of production. For obvious reasons this is a more extensive concept, in a functional sense, of innovation than the Oslo Manual TPP innovations.

However, in innovation studies it has proven difficult to implement Schumpeter's distinction between 'first mover' innovation and the adaptation of other firms to the innovator, between Schumpeterian 'new to the industry' innovation and the induced innovation, of existing firms adapting their own 'doings' to the innovator's 'way of doing things', that is an integral part of the diffusion process. In this latter sense, innovation as changes 'new to the firm' is wider than Schumpeter's innovation proper. The discussion of the innovation concept given in the preceding chapter implies that we should include both these extensions here.

We emphasised that any characterisation of innovation as technological or non-technological, product or process innovations etc. is subordinate to the basic aspect of innovation. Innovation is a market phenomenon, where its nature and dimensions are shaped by the perceived structure of competition on the markets where the innovating firm operates. Innovation from the firm point of view is primarily a response to the firm's competitive environment. By innovating, the firm contributes to changing the 'data' of the business environment of customers, competitors and other related firms, requiring innovative responses from these, and so on. This induced generation of collective activity by 'technological', defined as non-price, competition, is at the heart of the present understanding of innovation, its system dimensions and economic development. If anywhere, the engine of economic growth resides in this innovation driven generation of economic variety; as Schumpeter states "innovation is the outstanding fact" of economic development.

From this it should come as no surprise that service firms innovate extensively in this sense. This concept of innovation may be applied to any industrial activity, irrespective of the nature of the industry or product notions. Applicability of a further specification of innovation categories requires an adaptation to characteristics of the industry. Now, there are three characteristics that implicitly underlie the concept of innovation as a generator of economic variety; innovations are *deliberate* implementations of 'new ways of doing things', innovations are 'new' or *novel*; they exceed some minimal novelty 'height', and they are at least partially *codified*. The essential point to note is that these three characteristics are more or less directly satisfied for the 'blue print' approaches to innovation discussed in the last section. It is outside this restricted class of innovations that these criteria are less immediate.

The background material of the SI4S project gives a broad discussion of former attempts to conceptualise and interpret innovation in services (see Gallouj 1998a, Sundbo and Gallouj 1998b). A distinction may be made between *technologist, servicing relations* and *integrative* approaches. The larger part of the existing literature in innovation in services takes a technology-industrial perspective on innovation, concentrating almost exclusively on technological innovation in the restricted sense. Such approaches exclude 'co-producing' innovation processes that we have argued to be central for client intensive 'servicing' relations; innovations may "exist where the 'technologist' gaze perceives nothing". Central to many of these service oriented approaches is the idea that the intensity of the relation between service supplier and client allows for possibilities of service 'product/process' innovations that go beyond TPP innovations. It is for these client intensive servicing relations that the product/process distinction is particularly problematic; broadly speaking, the relation between supplier and client may be characterised as posing a production capacity or capability at the disposition of the client. Integrative approaches comprise attempts to devise general approaches to innovation, irrespective of divisions of service and manufacturing goods. Here the general idea is that innovation involves generic features across divisions between services and manufacturing, or between tangible and intangible products. The importance of these features depends among other things on the characteristic intensity of interaction between suppliers and clients on the markets in question, leading to a possible description of an innovation landscape in terms of a continuum of relation and/or product characteristics. It has been claimed that there is a process of convergence along this continuum between manufacturing and service industries.

In applying the innovation concept on service activities we have concluded that although the combined classification of services according to factor bias, functional orientation and client intensity implies that there are a series of specific characteristics of innovation in service sectors or functions, these characteristics still allow the use of the traditional taxonomy into product, process, organisational and market innovations. There are two features of service transactions that extend these categories beyond the TPP framework. First, where the client intensity is high, in the sense of co-production, the interface of provider and user may be the locus of interactive learning, generating the opportunity for new modes of innovation for the

service provider. Markets where client intensive 'servicing' relations dominate do not accord with the impersonal, or arm's length, model of markets that underlie blue print innovations. Secondly, a significant part of innovation patterns is 'soft', or non-technological, even when restricted to product and process innovations. Soft product innovations are frequent, encompassing examples such as new financial instruments in financial services, new sales concepts and formats in retail trade, bundling of new or altered peripheral services with the basic service product in, for example, person-oriented services, or architecturing of bundled services in information intensive services.

The aspects of service innovation

Attitudes of service innovation

We have noted that in general service firms have a well-developed product approach to their industry. On the basis of this we have distinguished *attitudes* of innovations, distinguishing between product and process innovations, organisational innovations and market innovations, as indicated in the previous chapter. In the surveys performed during the SI4S project, product and process innovations were distinguished. In identifying product innovations, the product concept of the individual firms was taken for granted, as this concept reflects the structure of competition on the firm's market. Thus the service product is what is supplied to or done on behalf of paying customers, reflecting the business of the product supplier. Process innovations are related to procedures and prescriptions of the process of generating the service product, the process of creating, assembling, composing or developing the service product that is being sold to customers or clients. The processes or methods by which services are "put together" includes the tools, materials and other resources, and the procedures, skills and the knowledge used to transform resources into commercial services. This distinction is made with the expectation that for firms with client intensive servicing relations this distinction will prove difficult to draw.

Organisational innovations covers several forms of changes in the structure of firms, ranging from adaptive reorganisation to integrate process innovations into the

organisation, to institutionalising new functional areas in the firm such as the establishment of an intra-firm marketing or an IT department, and to changes in the make up of the firm through BPR processes, switching to team based or matrix based organisations etc. In the framework of Table 1, this covers both the third and the fourth level, or fields of innovation. Market innovations correspond to entering new markets or niches or innovative changes in the way the firm organises its external relations; an example of the latter is the implementation of various forms of supply chain partnering.

Modes of service innovation

A different cut at product/process innovations in services was suggested above as a consequence of client interaction. The problem with a product/process taxonomy of innovation in such 'servicing' relations are evident; since the 'product' in these relations is an act of production, there are evidently significant problems in disentangling 'product' and 'process' because the 'product' is in a sense the 'process'. From the standardised product point of view, these relations are characterised by high customisation. But it is important to note that this is wider than the processes of 'impersonal' product differentiation, though it may share characteristics with these. The essential point is that the customisation appears as an interactive, co-producing process, and hence with strong elements of interactive learning between supplier and customer. From the point of view of the supplier, the processing interface with the client is a source of capability formation. Innovation is in this sense a process of generalisation of capabilities obtained in client specific relations. In these cases, we may denote the *mode* of innovation by behavioural aspects of the customisation process. We may distinguish five modes as outlined in the table below. In the last column we have specified some of the areas where the individual modes of innovation are dominant, as suggested by analytic arguments and empirical data (see Djellal and Gallouj 1998).

Table 2: Modes of innovation in services

Mode of innovation	*Customisation characteristics*	*Service provider*
Tailor made innovation	Products are tailor made to meet specific clients' requirements and needs; products are produced from 'scratch'.	Small firms Operational services
Ad hoc innovation	Implementation of service products require an adaptation or translation to client specificities. In such 'problem solving' provision the implemented 'product' is essentially co-produced with the client, as an interactive problem solving process, geared to the contexts of a specific client. These innovations are augmented by formalisations of implementation experiences through 'appreciative theorising' to enhance repertoires of implementation towards new users.	Expertise based service provision Knowledge intensive services
Recombination or architectured innovations	New products are essentially obtained by dissociation and new combinations of more or less standardised service elements.	Financial (mass) services Operational services
Differentiation or adjunct innovation	New products are obtained through addition of new or amended peripheral services.	HORECA Trade
Delivery or formalisation innovation	While retaining the basic function and characteristics of the 'service product', the mode of delivery or interaction with the client is changed.	Operational services Financial services

Source: Sundbo and Gallouj 1998b

Technological and non-technological service innovation

As we have emphasised, service innovation raises issues about the technological content of product and process innovations. The French and the Norwegian surveys together suggest the following characterisation;

- product innovations in service industries are predominantly 'soft', either non-technological or involving use of well-known IT tools,
- process innovations are inclined to be more technologically oriented than process innovations,
- to the extent that use or development (material) technologies are involved, it is predominantly with the use of information technologies.

Barriers to service innovation

The most frequently cited factors that limit innovative performance by service firms are (see Preissl 1998):

- public regulations, ‘red tape’ and fiscal systems,
- financial constraints of the innovating firm,
- management and personnel related constraints.

Drivers of service innovation

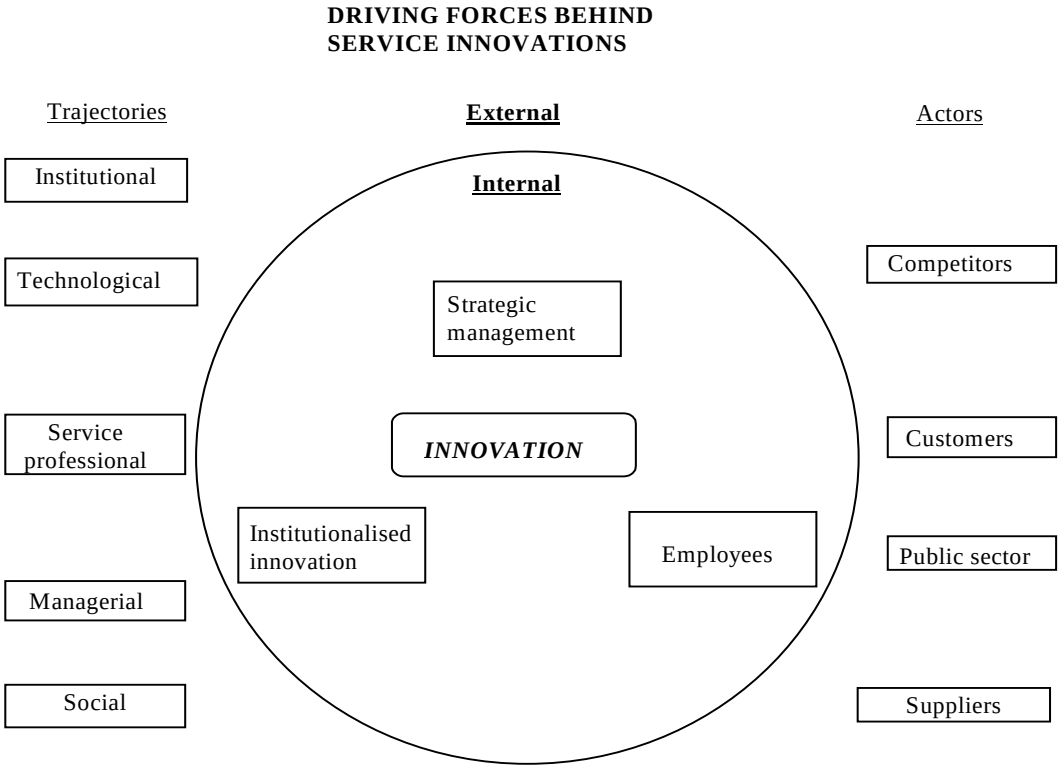
The innovation patterns of services firms vary considerably. The nature of innovation varies with location in the factor bias/orientation classification scheme, and with the scale of operation. The complexity of functional specialisations of labour plays an evident role; complex, or back-office intensive, services turn out to have different innovation patterns than other services (Gallouj 1998c). In information intensive services, the scope for the use of information technologies is very different from that in personal services. The particular innovation patterns in services must be understood on the basis of relevant specific characteristics of service production. Rather than describing specific innovation patterns in different service sectors, we will note some generic trends in the evolution of these innovation patterns which are valid for a wide range of service sectors. The model is presented as a general stylised taxonomy of innovation patterns in such functions.

Two generalised market forces shape innovation patterns, client intensity and participation and cost/price competition. In its basic form, innovation patterns can be characterised as ‘artisanal’ or crafts based, with a rudimentary innovation pattern taking the form of incremental changes generated by the satisfaction of specific user demands or through the uptake of new intermediate factors (Sundbo and Gallouj 1998b). The actants of this pattern are predominantly clients, competitors and suppliers. Firms do not generally have an innovation strategy: product innovation may be more a question of fashion. Process innovation is predominantly supplier led. Today such patterns are most apparent in operational tacit skill based services, such as cleaning, personal care, restaurants etc.

To understand the development of innovation patterns, we have outlined briefly below a model of drivers of innovation in services based on SI4S national reports and surveys. It can be seen that there are external and internal driving forces.

The innovation process in any firm must be understood on the basis of intra-firm drivers; innovation is a response to market opportunities formulated by the firm itself. There are three internal agents identified in the figure below, management and strategy formulation, employees and, possibly, institutionalised innovation efforts, for example, in the form of formalised innovation or R&D units.

Figure 1: Driving forces of service innovation. Source: Sundbo and Gallouj 1998a



The external forces can be divided into *trajectories* and *actors*.

Trajectories are ideas diffused through a social system which give innovation patterns character, or 'direction'. What this emphasises is not the specific actors involved in the diffusion process, but the ideas and the logic of innovation; the 'what we do and how we do it'. In terms of the characteristics of service innovation noted above, we expect a wider set of trends or trajectories than one limited to technological, or techno-economic trajectories, in the sense of Dosi. Three types of

trajectories are identified in the Sundbo and Gallouj 1998a, in addition to two more general trends:

- service professional and professionalising trajectories,
- general management ideas, BPR, service management etc.,
- technological trajectories,
- institutional or regulatory trajectories, shaped by regulations and political institutions,
- more social trajectories, reflecting evolution of general social attitudes and conventions.

Actors are persons, firms or organisations whose behaviour is important to the service firm's capacity for selling services and therefore also for their innovation activities. The actors constitute an environment that defines the market possibilities and they are also sometimes involved in the development of the innovations. Four sets of external actors are noted in the diagram. *Customers* are of course actors of major importance. *Competitors* also are important for innovation activities. *Suppliers* and especially KIBS suppliers are important sources of innovation as well. *Public sector and public policy* agents is a diverse set, playing a multiplicity of roles. The public sector may itself be a significant customer, competitor or supplier of service firms, as well as carrying out its role as regulating authority. Through S&T policies the public sector provides funding of innovation related activities, advisory and RTD services, and more generally through training and education policies. However, this latter role is of less importance as the empirical material shows considerably less integration between service firms and public knowledge infrastructures, as R&D institutions, public funds etc.

Shifting patterns of innovation

In the case study and survey material, indications have been found of an increasing formalisation of innovation activities in service sectors. On the basis of the model outlined above, six broad patterns of innovation activities have been identified (Sundbo and Gallouj 1998b):

- a craft based, artisanal pattern,

- an industrial, RTD dominated pattern, where two variants are identified, a Fordist-industrial and a neo-industrial variant,
- an entrepreneurial pattern,
- a service professional pattern,
- a managerial pattern, denoted organised strategic innovation,
- a network pattern.

Each pattern is characterised by a specific combination of trajectories, external agents and internal organisation. The simplest, craft based pattern is dominantly concentrated around a conservative organisation, focused on customers and other external agents, with a weak role played by trajectories. Innovation is informal and idiosyncratic, occurring through incremental improvement and learning processes. In the other patterns, of which service professional and organised strategic innovation patterns are the most relevant for service industries, innovation is an organised activity, with a higher strategic priority allotted to innovation in the firm.

While the craft based, more incidental approach to innovation is the prevalent pattern in most service industries, there is evidence that innovation activity is given an increasing strategic focus. However, the dominant trends are not towards an industrial mode pattern, with a pivotal role played by an R&D department or similar institutional structures. Rather, two paths seem to emerge. First, especially in capability dominated activities, a profession based approach is visible. The service professional pattern is characterised by informally structured innovation activities, in the sense that innovation is intimately tied in with the provision of capability based services. The organisation is change oriented and might be said to be nourished on change. Innovation will be mainly guided by a more diffuse innovation or business ‘culture’ than by formalised innovation ‘policies’ or strategies. The pattern is flexible, capable of rapid response to changes in the environment and in the basis of its activities, but susceptible to diffuse codification of innovative practices and routines. The innovation process may be characterised as a collective process; the professionals in the organisation are expected to participate and share responsibility. In this pattern, which is particularly evident in knowledge intensive services, a main driver of innovation is the individual professional’s expertise, with innovation located at the interface between user and producer.

In the managerial pattern a formalised innovation policy or strategy plays a more prominent role. There is, however, no separate and institutionalised product development or innovation function; the innovation organisation is diffuse. Innovation is management led, or guided, with innovation processes or projects often being undertaken by project groups. Sundbo and Gallouj characterise the innovation process as balanced entrepreneurship, with employees as corporate entrepreneurs within a framework of regulation and control by the corporate management. The managerial pattern of innovation organisation favours standardising innovations. Innovations are seen as relating to fairly stable, or standardised, product characteristics; the corporate focus of innovation is more product based than reputation based. Where it is formalised, the function of marketing and/or business development is expected to be the most prominent departmental function.

The survey data are not rich enough to draw any definite conclusions about distribution of patterns across sectors and trends in their development. We can identify three issues in the data. The French survey suggests that the innovation pattern of about 55% of innovating firms are either of the service professional, the managerial or the neo-industrial kind. Consultancies are indeed most likely to follow the professional pattern. The managerial pattern is also notable in these service industries. Financial services are more likely to follow a neo-industrial pattern, more similar to the dominant mode of organisation of innovation in innovation intensive manufacturing industries. The residual of 45% of the sample of firms will then probably consist predominantly of ‘artisanal’, or casual, innovators.

A factor and cluster analysis of the data on organisation of innovation in Norwegian service firms suggests that there are 5-7 broad patterns in organising innovation. Factor analysis indicates that the descriptions of innovation organisation[3] fall along three dimensions; an informal organisation, whether individually or teamwork based, an R&D/IT group dominated pattern, and a combination of market group and innovation focus. The fourth category of project group domination stands apart, but

[3] The surveys characterise innovation organisation in terms of (i) informal individual processes, (ii) informal teamwork, (iii) R&D group/department, (iv) IT group, (v) marketing and/or business development group as key actor, (vi) inter-departmental project groups as dominant model, (vii) characterisation of company wide focus or awareness of innovation.

is much closer to the latter two formally organised patterns than to the informal structure.

A large cluster of innovating firms, about 1/3 of firms in the sample, scores low on all dimensions and may be identified with 'casual' innovators. Another equally sized group is mainly made up of informal innovators, with a somewhat stronger institutional focus of innovation. The cluster is dominated by business services, wholesale trade and financial services. We interpret this as including the professional pattern described above. Two smaller groups of firms are dominated by formal organisational modes, respectively around R&D/IT and marketing functions, both with a strong role for project group organised innovation. While the first group points towards the neo-industrial variant indicated above, the second one points more towards the managerial pattern. There is an intermediate variant of these two groups, characterised by an important IT/market function, no separate R&D function, and predominantly project group based organisation. It is exclusively focused on business (and computer) services, its structure suggests close links to IT based software provision and consultancy. If that is the case, it may be interpreted as a variation of the professional pattern, adapted to these activities. The remaining two sets of firms are 'R&D' firms, informal organisation with a dominant role of institutionalised R&D, and a set of 'integrated innovators' that score high on all dimensions.

Sundbo 1998 argues on the basis of the Danish survey that the hypothesis that the innovation process has become more formalised can be supported, but only to a moderate degree. The most characteristic feature of innovation processes in service firms today is still their informality.

The general conclusion to be drawn is that patterns of innovation organisation in service firms do not follow any single developmental trend. Even among firms that themselves claim to have introduced innovations over the last few years, in a large share of these firms across a wide range of service industries, innovation is more or less incidental, with no or weak formalisation in terms of institutional structure. Similarly it is suggested that there will be a large category of 'informal' innovators, with a stronger organisational focus of innovation. For those categories of firms with a formalised pattern of innovation, 'traditional' formalisation in terms of institutionally formalised R&D or similar functions is suggested to be predominantly

ICT related innovation activities. A market-oriented model of formalisation is based more on inter-departmental project groups with a market or business development orientation. Not surprisingly, the sectors that have been suggested to be more likely to show these new patterns, are KIBS-sectors and financial services.

Tête-à-tête with Cinderella - KIBS services in innovation

Structural change and bridging functions

Characteristics of structural change in European economies

One of the outstanding characteristics of recent structural change in European economies is the growth of business services. More broadly, there are dynamic structural changes in the generation, use and organisation of knowledge intensive inputs into and within a large range of industrial activities. These developments in general and the growth of business services in particular are at the core of several major trends that are restructuring the economic landscape of European economies;

- the emergence of complex and flexible network structures in economic production,
- the enhanced importance of generation, diffusion and absorption of systematic, often scientific, knowledge and capabilities in industrial activities,
- the increasing scope and integration of ICT technologies and infrastructures, restructuring existing and giving rise to new activities, and raising complex needs of systemic interfacing at all levels,
- increasing globalisation and new trade regimes, altering competitive frameworks,
- regulation and de-regulation at national and trans-national levels.

The emergent structural patterns and 'complexification' of national and international economies are known by many names, 'service', 'information', 'knowledge' or 'learning' economies; what is common to these epithets is that they are intended to emphasise new and stronger inter-dependencies between economic production and its wider socio-economic environment.

It is nothing new to say that economic production is systemic. This 'modern' aspect of economic life has its roots back in the commercial revolution of the 16th and 17th centuries. Today the economic system is a sophisticated inter-related functional system, with complementary relations between a wide range of specialised functions. With integrationist approaches to economic development, it is evident that the

functionality of the overall economic system is intimately linked to the efficiency of inter-linking and co-ordinating these specialised functions. In a very natural sense there is an inter-dependence on innovation and wider change processes across functional borders (see f.i. Hauknes 1998). The role of service of service functions for overall innovation can be illustrated by the long history of interaction between distribution and financial services on the one hand, and manufacturing production on the other. The container revolution (for a brief account, see Ernst 1982) involved a system-wide reorganisation of freight transport with broad repercussions for distribution patterns and market range.

Bridging functions – Knowledge distribution and production

The new additional feature, and the object of SI4S studies, is the realisation of knowledge as a significant factor of production. The focus on knowledge and information as a separate production factor in its own right has intensified in modern economies, through its role in shaping development and use of the traditional factors of production, labour, land, capital, and entrepreneurship. With the trends indicated above, the volume and turnover of information available has increased manifold, as has the demand for information, and for analytic capabilities in selecting, refining, transforming and using information. These tendencies have further reinforced the processes of professionalising business practice, of the growth of managerial capitalism, in the Chandler sense. The increased strategic importance of access to and capability to use information and knowledge inputs rapidly emphasises the importance of being able to identify, transform and regenerate these inputs to enable direct and indirect implementation. These bridging functions between flows and repositories of information and knowledge external to a firm and internal use of (regenerated) information and knowledge are vital for a firm to achieve effective dissemination and use of these inputs.

The recognition that in any economic system the relations between actors and the co-ordination of production activities there are two dual processes going on, namely, the organisation and flow of goods and services in transaction and production processes and transmitting and interpretation of information is today an integral part of our understanding of economic systems. Though our comprehension of the ‘why’s and

'how's of these processes is still poor, we are beginning to get a better understanding of these questions. The professionalised bridging functions have mainly been retained within large corporations, seemingly confirming the view of knowledge and information as a public good in terms of its external characteristics. The notion of information as a public good has increasingly been challenged by the realisation that the foundation of these bridging functions is that the necessary interpretation process of externally acquired information indeed gives information properties of excludability and rivalry.

The perspective underlying the realisation that information and knowledge as private goods is that information and knowledge are not acquired cheaply; they must be interpreted, reformulated and assimilated, they must be learnt, to form the basis of (new) behaviour. This resource-based view of the firm, with capabilities and competencies as a central dimension of what constitutes a firm, implies that competencies and capabilities and hence learning processes are localised or specific, rather than global and general. The indicated trends have facilitated a process that permits the emergence of knowledge markets, of a rapid external growth of a class of functions that have been termed knowledge intensive business services.

The externalisation of knowledge intensive services and the rise of knowledge markets lead to specialisation in the bridging functions and allow flexible use of expertise by the users, as well as allowing for a more general use of these functions, as by SMEs. Increasingly, these bridging functions are encapsulated in new bridging institutions within the 'learning' economy. The knowledge intensive service firms play a role in national innovation systems that supplement and broaden the generative and distributive functions that have been traditionally the responsibility of the public technological infrastructures, R&D institutions, advisory and extension services etc.

It would seem to be a paradox that as the volume and accessibility of information increases, there seems to be an insatiable demand for more information and knowledge. However, internationalisation of trade and trade regimes, network organisation and internationalisation of information, enhances the importance of strategic information for the whole economy. The growing importance of bridging between external repositories and flows of knowledge, the sourcing of external

capabilities and expertise and internal competencies and capabilities, clearly increases further the need to tap into these flows. Knowledge intensive services like bridging institutions are evidently at the centre of these processes while also themselves promoting a process of cumulative causation that may possibly affect the general division of labour in knowledge production.

As noted, the bridging function is essentially the creation and adaptation of channels of communication between external and internal repositories of knowledge. However, it is important to note that these flows are not like 'energy' flows. The essential feature of such bridging functions is that they require genuine transformation and regeneration into the specific circumstances of any firm; they require bridging between generally accessible knowledge and information and localised capabilities and competencies. Hence the importance of specialised appreciative transformation capabilities for entrepreneurs.

The growth of knowledge intensive services thus has a profound effect on the distributive capacity of innovation systems; by increasing the connectivity of these systems through generating new and extending existing flows of knowledge and information, while generating specialised transformation expertise. The efficacy of intermediary bridging functions requires the additional development of clients' absorptive capacities, interfacing the intermediary functions with firms' capacities to act on the basis of the new information and knowledge - in short, on the ability to learn. The ability to learn, to absorb and implement external knowledge into capabilities and skills, and to select areas of learning, becomes a central competitive parameter.

The generation and diffusion of innovations and information relies more and more upon knowledge generated not only by learning processes implemented by internal research and development laboratories, but also, and to a growing extent, by the daily interaction, communication and trading of information of learning firms among themselves and with other scientific institutions. Knowledge intensive business service firms play a major role in this context as qualified interfacing bridging institutions.

The intensified role of such processes indeed underlines the aptness of the label of a knowledge intensive or learning economy. Obvious characteristics of the emerging knowledge markets and bridging functions and institutions are then (i) suppliers with specialised functional and intermediary expertise and skills, and (ii) interactive learning between suppliers and clients that impacts clients' production capabilities and competencies. The latter point implies that the bridging institutions are producers of intermediate inputs; their clients are other firms and organisations, both within the private and public sectors. The criteria for identifying knowledge intensive business service suppliers as new bridging institutions are;

- the constituent role of suppliers' specialised expertise, usually integrated with professional knowledge. Their employment structure is generally expected to have a high share of high-skilled personnel, usually with academic or tertiary training,
- they supply dominantly intermediate inputs, rather than output for final consumption. Their 'products' may both be bundled with or supplied independently of other tangible or intangible input factors,
- the 'products' are intended intermediate inputs into clients' knowledge generating and processing processes. The bridging functions produce services that may be said to be essentially 'knowledge intensive', both in terms of the factors that go into their generation, and in terms of required capabilities to interpret and use these products.

These service functions act as converters of external information knowledge flows into localised competencies and capabilities and vice versa, so as to become problem-solving actors specialised in the provision of the complementary knowledge inputs necessary to firms to generate technological and organisational innovations. Such information exchanges, based on intensified receptivity and connectivity of learning agents and the consequent accelerated interactions between tacit and codified knowledge, seem able to account for much of the innovative capability of the European economy (Antonelli 1998a).

Aspects of the growth of KIBS sectors

When focusing on external provision of KIBS services there will be no standard industrial classification available, and the range of industries involving a considerable KIBS element may be very wide. This makes it extremely difficult to assess the volume of external activities in these functions, and such an assessment is

even more complex if we decide to include internal provision of bridging functions in firms. Nevertheless, the dominant group of firms performing these functions seem to be within the industrial category of business services, covering ICT services, consultancies, engineering and technical services etc. A survey of European industry experts was performed to identify sectors with a considerable KIBS element and to try to find some sectoral characteristics of the interaction between suppliers and clients and how they influence innovation processes in client firms (see Bilderbeek and den Hertog 1997). The most interactive, in terms of client intensity, KIBS firms seem to a large extent to be concentrated in these industries.

The sector of business services has been the most dynamic sector in European countries over the last decades in terms of employment growth. Employment in these services corresponds generally to some 5-10% of overall employment, total employment in these sectors having tripled since 1970 in the OECD area. The growth has been followed by a proliferation of new business areas that has rapidly changed the face of these industries. This employment growth and a similar increase in production has been accompanied by an increase in the relative weight of inter-industrial trade involving these industries in total intermediate trade. There has also been a shift of employment of higher educated personnel in national economies, with business services now accounting for a major share of the employment of these types of personnel, and a substantial inter-industrial flow of higher educated personnel between business services and other production sectors; business services contributes substantially to inter-industrial technology flows.

The following table, based on the OECD National Accounts data set, describes the share of real estate and business (REBUS) services, corresponding to the industrial classification category of ISIC 83, in national GDP and total employment. Being dominated by ISIC 832 business services, the numbers are a reasonably good indicator of the growth of the category of services described above. While the share of REBUS services in total GDP in the first half of the 1980’s was around 10%, towards the mid 1990’s the share has increased by some 30%. In terms of total employment the increase during the same period has on the average been around 50%. In comparison, the corresponding shares of total manufacturing in European economies are around 15-20%.

Table 3: Business services in European economies

	Share of real estate and business services (%)			
	GDP (current)		*Total employment*	
	1982	*1994*	*1982*	*1994*
Austria	7,4	11,8	3,4	4,6
Denmark	11,2	14,3	4,6	6,3
Finland	9,8	13,6	3,6	6,5
France	12,9	18,6	5,4	7,9
Germany (West)	6,7	8,1	n.a.	n.a.
Netherlands	11,6	13,7	6,0	9,3
Norway	7,3	9,6 (1991)	3,2	4,5 (1991)
Spain	11,5 (1985)	10,7 (1992)	1,7 (1985)	2,7 (1992)
Sweden	12,4	16,9	4,1	6,6
United Kingdom (incl. financial services)	15,4	23,2	8,2	11,9 (1990)
United States	16,8	19,6 (1993)	7,2	10,4 (1993)

Source: Preissl 1997

This implies that during the last two decades knowledge generating and distributing services have become a considerable sector of economic activity in European countries. There has not been an even growth along structural dimensions of these sectors. The growth has been accompanied by a restructuring of these sectors and their relations to other sectors of the economy.

In terms of inter-industrial trade Table 4, based on the OECD Input-Output data, measures the size of this trade relative to gross output for France, Germany, United Kingdom and the US. Inter-industrial trade is measured in the table as flows of goods and services between different sectors in the 35 sector classification used in the OECD I/O tables; hence it measures flows between relatively ‘distant’ sectors. These ‘off-diagonal’ flows correspond to some 35 - 40% of gross output in all countries. The average growth rates of these flows from the late 1970’s up to 1990 are comparable to growth in gross output, but with some national variations. In particular, from this 4-country set, there seems to be no general trend of increase in the relative share of inter-industrial trade. When we focus on business services, this picture changes. Reflecting the overall growth of these sectors, their share in inter-industrial trade has increased significantly over the period. A rough estimate suggests that this share increased by about 50% during the 11-13 year period. Nevertheless,

these data confirm that business service sectors account for a significant and increasing share of inter-industrial trade in these countries.

Table 4: Inter-industrial trade 1978-1990. Based on total flows in constant prices. Source: OECD Input-Output Database 1995

	FRA†	*GER*	*UK*	*US*
	1977-1990	*1978-1990*	*1979-1990*	*1977-1990*
*Inter-industrial trade**	34,0 %	37,9 %	42,6 %	34,3 %
*Inter-industrial trade, annual growth rate***	2,6 %	2,9 %	4,3 %	1,8 %
Gross output, annual growth rate	2,6 %	2,6 %	2,9 %	2,4 %
*REBUS in inter-industrial trade 1978****	16,1 %	11,6 %	4,8 %	10,8 %
*REBUS in inter-industrial trade 1990****	24,8 %	17,7 %	12,7 %	15,7 %

* 'Off-diagonal' trade as share of gross output

** Average growth rate of total 'off-diagonal' trade in the indicated period

*** 'Off-diagonal' trade originating in real estate and business services (REBUS) as share of total 'off-diagonal' trade.

† Data for France include financial services, trade originating in REBUS-sectors alone account for 16,5% in 1990. The decomposition is not available for 1977.

The relative growth of employment in business services entails a structural shift in employment of higher educated personnel (HEP, defined as formal educational background of at least ISCED 6, or first university degree or similar) in the market sectors of national economies. Business services are today a major employer of these kinds of personnel. A recent analysis of employment data for Sweden, Finland and Norway illustrates this. Business services, including industrial RTD institutions, today employ a substantial share of HEP in these countries. Table 5 below compares the aggregate of business services with total manufacturing; HEP employment in business services in absolute numbers is at least as large HEP employment in manufacturing. As shares of total employment, business services comprises the most HEP intensive sectors of the market based sectors of national economies. Their HEP intensity is comparable to a traditionally very HEP intensive and knowledge based sector in all economies - public administration.

Table 5: HEP employment in business services. Finland, Norway and Sweden 1995

		Finland	*Norway*	*Sweden*
Business services	*Employment*	162 246	140 253	335 192
	HEP employment	27 491	26 209	62 952
Manufacturing	*Employment*	393 160	279 664	754 400
	HEP employment	27 572	15 592	48 112

Source: Nås et al 1998

All industrial sectors have increased their HEP intensity over the last decades, an immediate consequence of the increases in and reforms of tertiary education and student enrolment rates in Europe. However, the recruitment of new graduates relative to present employment rates of HEP personnel varies. For some sectors, including business service sectors, the recruitment rates are substantially larger than the overall increase in supply of new HEP graduates. With HEP intensive business service sectors recruiting a larger share of new graduates, their present HEP intensities, and hence shares, are likely to increase even further. But there is also a considerable turnover in HEP personnel from business service sectors to other sectors of the economy. With inter-industrial mobility rates attaining values of some 10% of these labour stocks in the three Nordic countries, business services are also substantial sources for skilled HEP personnel for other sectors.

In terms of the classification scheme of services, according to factor bias, orientation and client intensity, outlined in Chapter 2, knowledge intensive business services are dominantly capability and skill intensive information oriented services, with high client intensity. As noted in Chapter 3 innovation patterns in these services increasingly fall into professionalised and management led patterns. These patterns are characterised by a diffuse structure of knowledge generation in the firm, with a generalised notion of knowledge generation or R&D as being a shared responsibility of professional personnel of the firm. The operational integration and diffuse pattern of these processes implies that the measurement of R&D (in the OECD Frascati manual sense) in KIBS firms is problematic. A contributing factor to the difficulty in outlining levels and structures of innovation and R&D in service firms is that the Frascati manual based surveys only recently were extended to service sectors in most

countries, and that the sampling frames are often badly adapted to cross-industrial statistical comparisons (see Hauknes 1996).

Nevertheless the available, though scant, evidence leads to the conclusion that concomitant with the growth of KIBS sectors in national economies, these sectors are now significant R&D performing sectors. Frascati type R&D performed in these sectors is predominantly related to *technology related* KIBS, in ICT services and technical or engineering services. To what extent this is reflected in the relative accentuation in responses of technologically oriented R&D is uncertain, but the distinction between a close association of formalised R&D and IT patterns of innovation and between business development and wider organisational 'gearing' towards innovation (cf. Chapter 3), would be supportive of this. Indeed, further support is given to this by the most recent Norwegian R&D survey, which in contrast to most other R&D surveys is based on a statistical sample of all service industries, along with manufacturing industries. Of total R&D performed in all service industries, about 2/3 is performed in ICT services (NACE 64.2 and NACE 72) and technical and engineering services (NACE 74.2 and 74.3), and technological R&D is dominant in all KIBS industries. R&D with a functional technology orientation is more likely to be formalised in accord with the requirements of the Frascati type surveys. However, we may already conclude from this that KIBS sectors are dominant in inter-industrial embodied technology flows. Based on Norwegian evidence, business and communication services are the sources of at least 1/3 of domestic embodied technology flows, the three 2-digit sectors of communication, computer and other business services being the three largest originating domestic sectors of embodied technology flows.

With the growth of KIBS services and their inter-relations with other sectors, these sectors have emerged as significant bridging institutions in national economies. These services play a significant role in the generation and distribution of new technology.

Functionalities of KIBS interaction – user-producer co-production

Knowledge and capabilities[4]

The interaction between KIBS suppliers and their clients takes a variety of forms. These knowledge flows can be tightly embodied or bundled into tangible forms, or they may be intangible. It may often take the form of direct human interfacing, especially in ‘sparring’ modes or it may involve non-human embodied forms of knowledge transfer. In addition, knowledge interaction between client firms and KIBS firms often forms the basis for the development of existing KIBS supply or of completely new services.

In cases where knowledge or competence is 'supplied' via traded firm-to-firm services we will have to struggle to map trade categories in a qualitative, finely-textured way - adequately characterising what-is-supplied and in what operational circumstances - before any attempt at quantitative and large-scale mapping will make sense. Innovation theories have tended to be about technological innovation. It may continue to be appropriate to speak about what is traded by KIBS suppliers in terms of 'technologies'. But if so, the term cannot be applied in any straightforward conventional sense since we are dealing with: (a) 'performed' service products rather than 'boxed' manufactured products, and with use-values of 'intangibles'; and (b) with mixtures of hard and soft technology which in practice are embodied in configurations of documents and humans, as well as machines, and which in trade may be 'transferred' in any of these embodied forms, as variable combinations of manufactured goods and delivered services.

Within an anthropological and historical frame it may certainly be useful to refer to something as 'soft' as spoken or written language as a significant and powerful technology. The term seems especially relevant when much of the linguistic and representational activity is formally codified and machine-like, as with technologies of management accounting or large-scale project control for example. But technologies in this broader sense have soft and elastic boundaries and form virtual systems in ways that make discrete units of trade difficult to define and system boundaries hard to police via legalistic conventions. The difficulty of characterising

trade in KIBS and adopting a broader historical view of technology is grounded in assumptions of discrete, detachable, unambiguously-located and thus unambiguously ownable physical units, grounded in commodity exchange.

The nature of the technologies employed in 'advanced' manufacturing has shifted, even within the short life of the term. The concept of advanced manufacturing has undergone 'tertiarisation', passing from a focus on hardware (and software as an extension of hardware functionality) to a focus on information, knowledge, judgement and competence; from technologies of manufacturing practice to technologies of strategy practice; from technologies delivered by manufacturing suppliers to technologies delivered by service suppliers. Alongside engineering and the operations of material transformation, the core technologies of successful advanced manufacturing production in global markets now include quality management techniques and models, process re-engineering strategies, continuous improvement strategies, supply-chain management models, techniques and instruments, etc. These are forms of conceptual discipline or practical rigour - interpretative 'arts' rather than technologies in a conventional, machine-centred sense.

Such technologies cannot be 'supplied' in the same way as manufactured products. We are here in the terrain of *competencies*. This can be regarded as a name for rather soft, diffuse and difficult kinds of more recently prominent post-industrial technology, when configured and embodied in *actual effective working forms*, in specific organisations and market settings. For the supply of these soft technologies, we must look to service organisations and service products rather than engineering producers and machine products. Rather than constituting quantitative 'flows' of discrete units across discrete boundaries – i.e. products of a conventional kind, commodities - technologies of these kinds tend to pass between organisations as service products which, although containing important material elements (documents, software, hardware, migration of people) primarily take the form of *interactions* within a practical space shared between producer and user. With such technologies, transfer hasn't occurred until success starts to be achieved – i.e. competence is actually demonstrated. This hard-nosed interpretation of 'transfer' is beginning to appear in commercial terms of reference - in Dutch consultancy

[4] This section is based on Hales 1998

practice, contracts are shifting away from input measures (e.g. the traditional costing in terms of consultant-days) to outcome measures (actual achieved changes in practice and performance). This 'no cure-no pay' approach is also emphasised in a recent *Economist* survey of consultancy[5].

Competencies pose a problem for mapping and measuring. They are systemic characteristics of concrete configurations of humans and non-humans; the term embraces both knowledge (as a characteristic attributed to humans) and technologies in the traditional sense (configurations of non-human objects). This systemic and hybrid character means that competencies can be difficult to define in a hard-edged, unambiguous way which facilitates quantitative measurement or even routine identification across sectors, cultures and organisations. Determining whether Total Quality Management or Continuous Improvement practices are present in an organisation or sector, for example, or whether they are effective as working strategies, may require a relatively complex operationalisation of the elements of these approaches and their effects, probably supported by some degree of dialogue to normalise the interpretations of different respondents. They are also hard to formulate as broad, semi-generic categories on the basis of research and observation of current business practice. This is partly because of the rate of change, and the continuing newness of some of the most relevant phenomena. But more fundamentally, the difficulty of mapping and developing comparable measures is linked to the following features of competencies:

- A competence is *what it does* (its effects); it is a performance or mode of performance with diffused outcomes and does not lie in some static and easily observable structural quality or configuration of apparatus.
- Competencies are not competencies unless they are embedded in *concrete operational contexts* (sectors, markets, national economies and systems of innovation, institutions with individual histories) as actual working arrangements of actors and resources;
- Truly strategic competencies are by definition *unique* and un-reproducible (at least temporarily, within a market segment or sector); and
- Competencies are systemic phenomena, distributed across many agents and actors interacting within a network of internal and external practices centred on a given firm, and oriented to some landscape of environmental conditions

5 The Economist, March 22nd 1997: p. 10-11

(strategic/operational context, national system of innovation, etc.) that is *historically, sectorally* and *geographically local.*

The concreteness of actual de-facto competencies makes it difficult, in the first place, to identify generic forms and, in the second place, to easily map their 'transfer' and diffusion. The underlying process might be better thought of as *translation* (an interpreting and creative re-making or mimetic process using local materials) rather than transfer or trade. Though the functionalities of the interaction of KIBS supply and use, namely the characteristics of KIBS user-producer linkages, are manifold, the transfer or translation is essentially a bilateral learning process; a co-production of capabilities.

Co-production of knowledge, client intensity and KIBS roles

The content and quality of the service provided by a KIBS is to an important degree defined by the quality of the interactive process and the degree to which service professionals of both client and service provider relate to each other. Some of the forms of interaction between KIBS providers and client firms are noted in the table below.

The degree and qualities of interaction between suppliers and clients vary between and within these forms. Tordoir 1993 has considered the interaction and integration of professional knowledge and expertise in business firms, in an approach that in some respects is akin to ours. He distinguishes three basic modes of service provision, of client interaction and intensity;

- *sparring* relations. These relations are the 'classic' consultancy leader type mode of interaction, in which the consultant integrates into the client's situation in an interactive manner. The relation is a mutual, but unbalanced 'co-producing' relation of problem-solving, with the non-expert client guided by a socialising consultant. These relations are most frequent in strategic and organisational problem solving,
- *jobbing* relations, where the expertise and knowledge of the KIBS provider has a specialist or technical character. In these, often highly interactive, relations the client is itself an expert, designing and directing a process of service provision, often in a project form, that has more of a character of 'provisions of solutions'. This is thus a relation where client generalist expert interact with KIBS specialist expert, in a more balanced 'co-producing' relation. An archetype of jobbing relations is the formal and informal relations between R&D intensive firms and R&D institutions. Tordoir claims that jobbing relations are usually more

knowledge intensive than sparring relations. Jobbing relations are frequent in engineering and technical service provision, as well as in provision of market research, human resource management and IT services,

Table 6: Some ways and forms in which various sorts of knowledge flows between service provider and client firm and vice versa. Source: Bilderbeek, den Hertog, Marklund and Miles 1998

• Training/instruction • Benchmarks • Project management • Help in specifications for procurement • Routine problem-solving as part of everyday project work • R&D collaboration • Instruction when installing new machinery • Software package • Written report • Drawings/designs • Sparring partner (testing of ideas client firm) • Presence • Advice • Computation • Use of an R&D facility	• Diagnosis • Extension of network • Market information and analysis • Brokerage / coupling to new partners • Knowledge on how to create support for innovations • Collaboration in project teams • Participation in conferences/seminars/workshops • Patents & patent applications • Product documentation (manuals etc.) • Feasibility studies • Drawings & project plans • Knowledge included in equipment and their operation • Articulation/specification of needs

- *selling* relations, which is comprised of 'pre-packaged' service provision; the services provided have been developed by the KIBS provider at her own risk. The user-producer relation in provisions of such 'turn key solutions' may be more distant, or arm's length, with the procurement of a product resembling acquisition of capital goods. In such relations the client is usually non-expert, buying in the 'boxed' service product encapsulating a specialist expertise on the hand of the provider. In the pure selling case, the process of adaptation and implementation of the service product is the sole responsibility of the client.

Tordoir's object of study is primarily the first two types of relations; his focus is a two-way study of internal and external provision of professional services. In actual situations of procurement and interaction, though one may be dominating, there is very often a mix of sparring, jobbing and selling relations between provider and client. As long as relations to some extent involve sparring and jobbing, the relation between the two parties may be characterised as a co-producing relation at a point where the generic, horizontal expertise of the KIBS provider meets the vertical, specific and localised knowledge of the client. The capability transformation process

at this meeting point is the central aspect of the interactive learning process; both parties leave the encounter with altered 'knowledge matrices'. This encountering of 'knowledge matrices' emphasises the importance of absorptive capacity; proficiency of the client towards the expertise of the provider is a necessary prerequisite for such 'knowledge matrices' to meet or overlap in a sufficient degree to allow impact of the interaction process on the clients' operations or behaviour.

As hinted at above, the Tordoir approach shares several common characteristics with ours. However, from our perspective there are essentially two short-comings to Tordoir's outline. His professional services include substantial amounts of our KIBS services, but whereas he mainly focuses on relations that include a substantial amount of 'on the foot' interaction, or what we have termed human-embodied interaction, we emphasise that substantial KIBS mediated innovation influence is through interaction that falls outside this pattern. The other, more significant aspect is that we focus here more on the process of innovating in client firms that is the result of such interaction than on the process of interaction itself.

However, Tordoir's three modes of interaction are important as background; they emphasise modes of interaction that are present, to varying degrees, in almost all KIBS interaction. Though knowledge intensity is usually thought of in terms of knowledge inputs into the production of the products, knowledge intensive products will usually require, whether interactive or unilaterally, adaptive learning by the client as well. When focusing on the role of KIBS services in client innovation, three different aspects can be discerned:

- *KIBS provider as facilitator of innovation*. A KIBS firm is a facilitator of innovations if it supports a client firm in its innovation process, but the innovation at hand does not originate from this KIBS firm. Nor are the innovations transferred (from other firms) by this KIBS firm to the client firm.
- *KIBS provider as carrier of innovation*. A KIBS firm is labelled as a carrier of innovation if it plays a role in transferring existing innovations from one firm or industry to the client firm or industry. However, the innovation at hand does not originate from this particular KIBS firm.
- *KIBS provider as source of innovation*. A KIBS firm is labelled as a source of innovation if it plays a major role in initiating and developing innovations in client firms, mostly in close interaction with the client firm.

In addition to their role in the process of provision, these KIBS services may also play an *indirect* role of knowledge transfer through employee mobility, whether to client firms or to other firms. Compared with average labour mobility rates, employees in Dutch business services, and in particular technology related KIBS, appear to be substantially more mobile: average job mobility in R&D services is 7.3%, in architectural and/or technical engineering services 8.4% on an annual basis. In the Norwegian case we have shown that labour mobility of personnel with tertiary level education from business services has a significant influence beyond the effects of trade flows on total factor productivity in the receiving sectors.

This tripartite division of the role of KIBS providers picks up a core issue of the bridging role of KIBS in knowledge distribution; this scheme is indicative of a process that we expect to be an important aspect of recent processes of restructuring of innovation systems. These KIBS functions play, and have always played, a central role in determining patterns of innovation diffusion processes. The fact that there is increasing externalisation of these services, and that this allows the possibility for (i) a proliferation and specialisation of the scope of these services and for (ii) opportunities for new categories of firms, like SME's, to access these services, implies basic changes of distribution and diffusion patterns of core innovation inputs and of innovation outputs, as well as creating diffusion patterns for new forms of innovation.

Innovating while interacting with KIBS

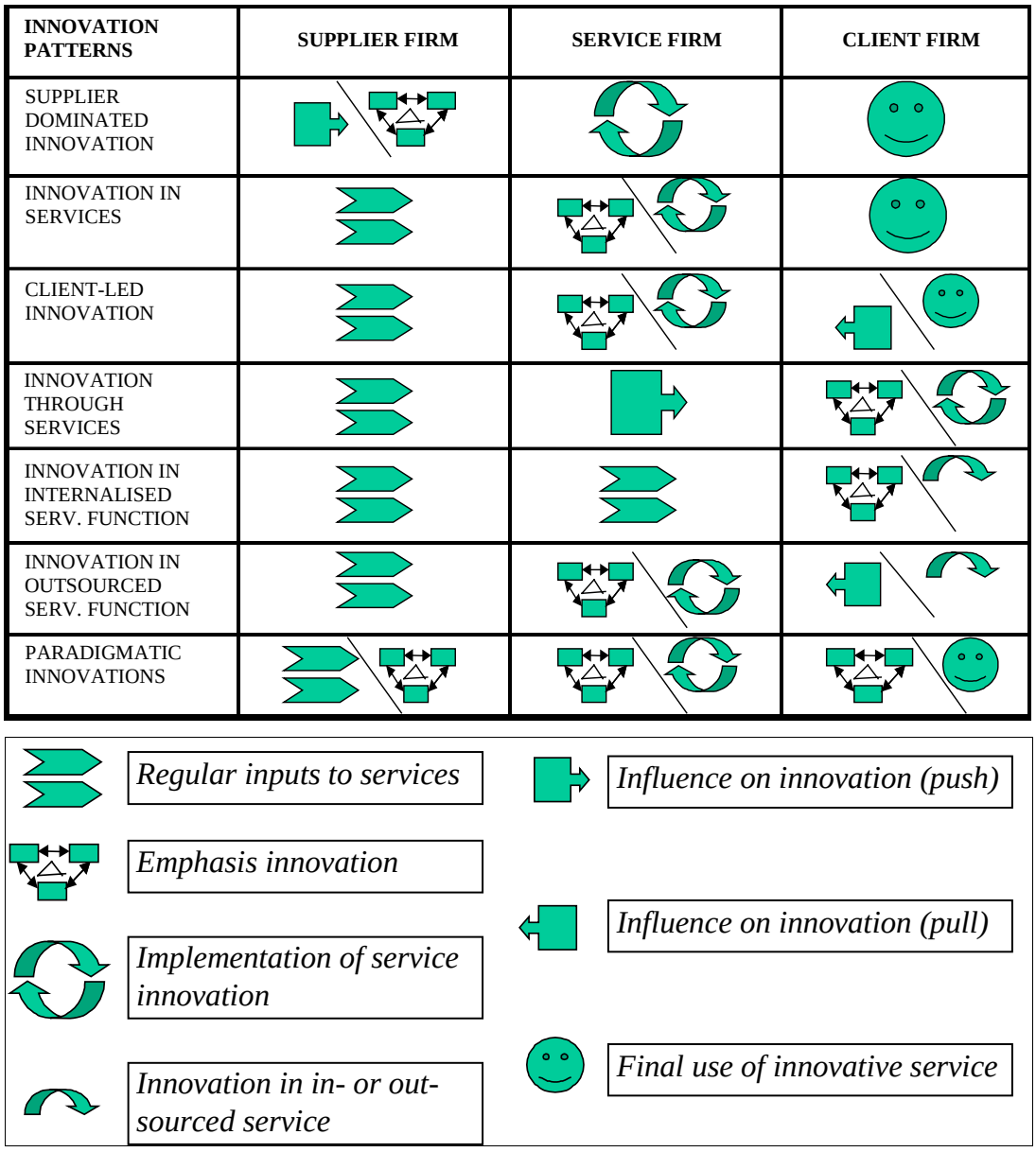
Thinking on services and services innovation has progressed quite remarkably in the last decade. As discussed in other places, a substantial part of this literature retains a 'technologist' basis for approaching service innovation. We have seen in the synthesis of SI4S work package 3/4, Sundbo and Gallouj 1998a, that although a technology dimension may be important to a large share of innovation processes in services, we also saw that a limited concept of technological innovation runs the danger of neglecting substantial parts of the innovation dynamics of services. As argued above, at the very least we have to extend the concept of technology to cover soft technology issues. More recently, in empirical studies, there has been an increasing and welcome emphasis on the complementary dual relation between

softer, organisational, issues and technological product and process innovations in manufacturing industries. This is a valuable extension of the present state of innovation research and will undoubtedly give a better insight into innovation processes, conditions for their development and generation of impacts from subsequent innovations.

Processes studied within the SI4S framework indeed make it clear that KIBS may play a significant role in these cases. However, if we focus on interaction between KIBS providers and manufacturing firms, there is a case for going beyond this dualistic approach to technological product/process innovation and organisational adaptation. This entails in particular the denotation of technologies of strategy practice used above. Such interpretative 'arts' are stabilised in terms of ‘practices’ through the interaction between a KIBS infrastructure, including management research and development, and various client firms.

On the basis of the SI4S material, a scheme has been developed for a differentiation of possible roles that service functions, and KIBS in particular, may play in innovation processes (cf. Figure 2). Seven broad innovation patterns are identified in this scheme, distinguished on the basis of the relationships between the KIBS-client interaction and potential suppliers of equipment, human or other resources, etc. The first category of ‘supplier dominated innovation’ is the traditional view of service innovation and its impact in supply chains. An innovation in an upstream supplier firm is implemented in the midstream service providing firm. The technological view of innovation in services would here tend to emphasise the role of technology-dominated back office innovations in the service firm, which may or may not be adapted and implemented in a recursive fashion between the upstream supplier and midstream service firm.

Figure 2: Service functions in innovation patterns. Source: den Hertog and Bilderbeek 1998b



This perspective on technology-led back office innovation stresses the indirect and diffuse impacts on the downstream service user. This is particularly well illustrated in Barras' model of the 'reversed product cycle' (cf. Gallouj 1998c). The onset of the innovation cycles are caused by technological innovation in supplier industries, leading in the cycle's first period to dynamic (back office) process innovation in the service industry, regarded as technology user industry. The benefits acquired by the service users may be carried over as pecuniary externalities; in this case there are diffuse benefits but they do not ordinarily require or provoke innovative action in the client firm. Or, which is more relevant for the KIBS case, the service firm may act as an assisting mediator of process or ancillary innovation in the client firm. This

distributive case is characteristic of processes of investment of capital goods. From the perspective of the client, the KIBS firm would tend in such cases to be seen mainly as a carrier of innovation.

The second and third case in the KIBS case concentrates on innovation processes in the midstream service firm, with the third as a variant of the second. The distinction between them refers mainly to the involvement of clients directly or indirectly in the innovation process. In the more client-intensive case, we recognise the 'ad hoc' and 'formalisation' innovating consultancy mode KIBS firm; the experience of adaptation of KIBS expertise to the specific and localised capabilities of the client increases the 'genericity' of KIBS expertise, and hence generates externalities through increased applicability of this. In such cases, where the co-production element is very prominent, the client firm will be expected to emphasise KIBS's role as sources or facilitators of innovation.

The next pattern, 'innovation through services', deals with KIBS firms as change agents in innovation processes in the downstream client firm. A dominant mode is the jobbing relation of clients to 'technical' expertise, but the innovation assistance role covers equally more problem-solving sparring relations. As with R&D and other extensive knowledge generating services, these relations may often be claimed to be a combination of the third 'ad hoc' innovation and fourth patterns; when we use a wider 'act' or process interpretation of interaction with KIBS and of innovation, it is difficult to discern 'innovation' from the nature of the service provision itself. In these 'innovation through services' modes there is no preferred role for the KIBS function in terms of its impact on client firms' innovation processes.

The remaining categories concern either intra- and extra-mural 'sub-contracting' relations, or the more rare variant of 'paradigmatic' innovations. In the last variant, the innovation pattern requires the development of infrastructures or wider service systems.

The impact of knowledge intensive services – the macro evidence

A way of testing systematically for effects of KIBS supply on its client sectors, as a way to complement individual case studies and sectoral analysis, is to turn to

econometric evidence. As part of the SI4S exercise we performed a systematic econometric analysis of the impact of the trans-nationally closest approximant to KIBS inputs, the intermediate use of outputs from business and communication services in other sectors of the economy as measured through available national accounts. As we have seen, knowledge-intensive service firms play a major role as bridging institutions. These firms are able to integrate their command of horizontal knowledge with the localised knowledge of their clients. Hence we expect to see a systematic correlation between the rates of penetration of business services, and the rates of introduction of new technological and organisational innovations, as measured by the rates of growth of total factor productivity. The hypothesis is that there are productivity enhancing effects of the co-evolution in the use of business and communication services, which is to say that there is a correlation between the rates of growth of use of communication and business services and the rates of growth of total factor productivity.

Work within the framework of SI4S has indeed confirmed that not only the levels, but also the rates of growth in the intensities of communications and business services leads are significantly associated with the growth in the intensity of business services.

Total factor productivity can be "explained" by the diffusion of communications and business services. It is clear however that there is no justification for considering that the residuals of the empirical estimation of production functions can attributed to the diffusion of communication and business services alone. For our purposes it is sufficient to assess the role of the diffusion of communication and business services as: a) a signal of the more general process of modernisation of firms and hence of their innovative capability; b) a factor itself, among others, in the actual increase of total factor productivity.

The following tables collate some of the results of these analyses for six countries, Germany, Greece, France, Italy, Norway and United Kingdom, on the basis of available input-output data. For data descriptions and discussions of results, see Antonelli 1998a, Katsoulacos and Tsounis 1998. The first table gives the econometrically estimated coefficients of aggregate production functions, in which the sectoral input of KIBS services (variable *B*), interpreted as communication and

business services, has been treated as a factor of production alongside capital (*K*) and labour (*L*) inputs into (adjusted) sectoral value added (*Y*). Coefficients' *t*-values are given in parenthesis. A pooled regression of two or three years as indicated was performed in all cases. The coefficients thus correspond to average values over the included years apart from fixed effects related to each year.

Table 7: *Regression equation* $ln\ Y = \delta + \alpha\ ln\ L + \beta\ ln\ K + \gamma\ ln\ B$

Pooled	*Years*	α	β	γ	*BS Cost shares*	*N*	R^2	*F*	
NOR	1983 1988 1993	0,439 (10,65)	0,327 (14,78)	0,220 (5,80)	7,7%	123	84,0	382	Ex. SNA 24+25
ITA	1985 1988	0,473 (3,57)	0,516 (7,48)	0,273 (2,77)	15,7%	32	94,5	137	
UK	1984 1990	0,444 (5,48)	0,32 (6,41)	0,327 (2,11)	19,3%	32	93,1	155	Goods sectors
GER	1986 1990	0,78 (7,48)	0,051 (3,39)	0,280 (3,21)	15,5%	23	94,9	147	
FRA	1986 1990	0,273 (7,48)	0,616 (3,89)	0,261 (2,01)	16,3%	25	89,5	87	
GREECE	1980 1988	0,409 (6,91)	0,418 (7,53)	0,173 (3,99)	n.a.	75	85,9	190	

The sixth column gives the corresponding cost share of communication and business services in value added. The last three, but one, columns give respectively, the number of sectors included in the regression, i.e. the level of disaggregation of the economy in question, total R^2 and *F*-value for the regression. The last column states that the Norwegian analysis is done for all institutional SNA sectors except government and municipal services. The UK analysis considers only factor inputs to primary and secondary sectors. For all countries the coefficient of business services is significant, and its value is indeed significantly larger than the cost share. The cross-sectoral evidence in Table 7 indeed confirms the hypothesis.

For two countries, regression equations have been considered on comparable difference form. These regressions estimate the impact of the relative growth in KIBS inputs on growth rates of sectoral output, rather than levels on levels. The

Italian case confirms the hypothesis that there is a significant relation between the growth of KIBS inputs and output growth rates.

Table 8: Regression equation $\Delta Y/Y = \delta + \alpha \Delta L/L + \beta \Delta K/K + \gamma \Delta B/B$

	α	β	γ	N	R^2	F	
NOR 1983-1988	0,463 (2,87)	0,308 (2,46)	-0,056 (0,66)	123	23,0	12	Ex. SNA 24+25
NOR 1988-1993	0,896 (9,40)	0,035 (0,35)	0,064 (1,29)	123	58,6	56	Ex. SNA 24+25
ITA 1985-1988	0,338 (1,76)	0,487 (4,45)	0,270 (2,45)	32	88,1	68	

The two-period Norwegian analysis however, did not yield results significantly different from zero; we were not able to exclude the possibility that there was no effect of business services on output growth rates in this period. However, as may be seen from the result for the second period of 1988-1993, the capital and labour coefficient values and their significance levels suggest that there may be other factors at work. A Greek test of the relation between growth rates has also been performed, albeit in a variant form. It gave a statistically significant coefficient of business services, in line with the Italian case.

An attempt was made to bring the Norwegian analysis further. As suggested above, supply of KIBS services may also benefit firms and sectors that are not intensive users of KIBS services. As KIBS firms generate expertise and capabilities that are valuable to potential users, we expect an increase on labour markets for demand of KIBS-skilled personnel. As other firms employ personnel with experience from KIBS functions, they complement the organisational capabilities of the receiving firm and hence contribute to a productivity enhancing effect independent of direct supply of KIBS services. Based on detailed employment data for the Norwegian economy, these mobility flows have been mapped for the period of 1986-1994. The data insists that pay attention to such labour flows of professional personnel: the analysis is restricted to flows of personnel with a minimum level of first degree tertiary education. By constructing the input-output structures of the mobility flows,

these may be compared with the input-output flows of goods and services. In general, the flow structures imply that although, as expected, major shares of mobility flows are to main user sectors of KIBS, these mobility flows also include a considerable share to less intensive user sectors. We may then estimate the effect of these labour flows by considering the labour flow effect either separately or conjointly with traded KIBS inputs. A preliminary regression analysis along these lines comparing the development over a period from the mid-1980's to the first half of the 1990's further supports the hypothesis that there is an independent productivity enhancing effect of labour mobility. This analysis will be further refined in future work.

The results above confirm that the diffusion of communication and business services is strongly associated with the growth of output (controlling for the rate of increase of the two basic production factors). The effects, in terms of output elasticity of communication and business services as strategic intermediary inputs, are very high. These results can be read in fact as an indicator of the extent to which the diffusion of KIBS services can be considered as a reliable proxy of rates of adoption and effective implementation of the wide array of technological and organisational changes.

A significant portion of total factor productivity growth experienced by several European economies during the late 1980s is the outcome of the interactions between:

- development and diffusion of new information and communication technologies;
- its effects on tradability, divisibility and transportability of information;
- a growing role for business service industries in the introduction of new technologies.

At this point it seems credible to propose that the European economy's technological and organisational capacity is a factor of its employment of communication and business services and therefore, the diffusion of these services is proportional to the diffusion of new networking technologies; such a demonstrable process should result in increased productivity levels. The use of communication and business services as strategic intermediary inputs by the rest of the economic system should be supported with policy schemes specifically designed to favour their development and diffusion both from the demand and the supply side.

Conclusions

The generation and diffusion of innovations relies more and more upon new technological knowledge which is generated not only by learning processes implemented by internal research and development laboratories but also and to a growing extent, by the daily interaction, communication and trading of information of learning firms among themselves and with other scientific institutions. Knowledge intensive business service firms play a major role in this context as qualified interfaces. Knowledge intensive business service firms in fact act more and more as bridges and converters between technological and business expertise and localised knowledge and capabilities, becoming problem-solving actors specialised in the provision of the complementary knowledge inputs that allow the generation of innovations.

We emphasise the following main findings of the SI4S work in this area,

- KIBS perform *par excellence* a catalyst role in knowledge-creating or innovation processes of client firms. Their role varies from adding innovative knowledge originating from the KIBS itself (KIBS as a source of innovation), originating innovative knowledge from another source to the client firm (KIBS as carrier of innovation) or helping out a client in implementing new knowledge mostly developed in house (KIBS as a facilitator of innovation).
- KIBS do play an important role in the various knowledge conversion processes. It can even be concluded that KIBS play a key role in transforming firms into learning organisations.
- The types of knowledge interactions induced and triggered by KIBS are not confined to the discrete/tangible, contractual, explicit/codified and non-human embodied forms of knowledge transfer. On the contrary, the functioning and role of KIBS can only be understood if we include process-oriented/intangible, non-contractual, tacit and human embodied forms of knowledge.
- KIBS and their clients have a sort of relationship that might be characterised as an symbiotic relationship. They – or at least the professionals they employ - profit from the interaction with the client firms and the various types of knowledge flows generated during this process of interaction as much as the client firm does. The experience gained during a given project will be used as a basis for developing new service products and approaches and will make the involved professionals more valuable professionals towards future clients with similar problems. KIBS are by the nature of their activities in contact and co-operate with quite a number of client firms and their employees, constantly diffusing and absorbing knowledge, reprocessing it, diffusing it again, etc. Through their activities they act as bridging institutions in innovation systems (at whatever scale) and contribute considerably to the ‘knowledge distribution capacity’ and learning capacity of innovation systems as a whole.

In the next chapter we will consider somewhat more closely an innovation system perspective on the issues covered so far.

Dancing with Ghosts - Innovation systems and services

On the concept of innovation systems

Since its inception about 10 years ago, the concept of 'national innovation systems' has gained wide popularity in both research on innovation and technical change and in deliberations on innovation and technology policies. In the OECD Technology/Economy Programme a 'systemic' approach, and through this the concept of national innovation systems, was used as a main backbone for mediating and making sense of a broad array of insights on technological change and economic growth. The approach was used to call attention to characteristic features of why and how firms innovate, and to the need for the scope of technology policies for national technological opportunities and capabilities, to 'technology in a changing world'.

With systemic, multifunctional and interlinked, innovation, the concept of innovation systems is evidently inter-woven with industrial dynamics, intimately linked as these systems are to the relations between innovating firms and their environment. At the same time their structure and functionalities are affected by initiatives beyond the commercial objectives of firms. Policy measures like R&D or diffusion programmes, and establishment of technology service institutions may have permanent impact on the structure of innovation systems. As a representation of systemic innovation, innovation systems have both endogenous and exogenous dimensions.

Nelson's notion of innovation systems is primarily based on an organisational approach, focusing on the role of an institutional technological infrastructure, comprising public or para-public knowledge generating institutions and public programmes and initiatives towards technical change, and its relations to business firms. In contrast, Lundvall's functional approach is a broader conceptualisation of innovation systems, focusing on interactive learning as a general complementary aspect of economic interaction. As such it encompasses both the structure of economic interactions, the exchange relations, and the social and institutional structure within and around these 'economising' relations, and hence allows a much

richer analysis. Our approach is the same as Lundvall's. Innovation and learning are social processes, embedded in a wider set of social action; hence the economic system and a wider social system may become practically indistinguishable when dynamic changes in the system of economic agents are considered. What first of all distinguishes an innovation system is our particular focus; innovation processes as generators of change in the economic system, and their repercussions in terms of social changes, *mediated through* the economic system.

Three insights have facilitated diffusion of the innovation system concept. First, innovation is a basic characteristic of market systems. As market systems cannot ever be perfectly isolated from creation of commercial opportunities and challenges, knowledge about which is costly and time-consuming to acquire, the structure of competition is altered. The information requirements of actors are far from satisfied by information being mediated by price differentials. Innovation becomes a natural mode of acquiring competitive advantages, requiring significantly richer information. Incessant innovation leads to a market 'history'; innovation is 'dynamic' or 'historic' in a strong sense, where price-based market histories are time-dependent in a much weaker sense. Hence, innovation is a central explicant of dynamic, endogenous evolution of market systems.

Secondly, the role of 'technological', or non-price, information in market systems implies that innovation is an economic phenomenon that involves all the different ways firms acquire information about such opportunities and shape and utilise them for commercial purposes. Innovation is multi-functional; information gathering and use, and related development of capabilities, are integrated into firms' ordinary commercial functions and objectives. Innovation, the realisation of such opportunities, involves a recombination of factors from various dimensions of these functions and activities.

Thirdly, it is a multi-organisational phenomenon; from the vantage point of an innovating firm, innovation is shaped by interactions between this firm and multiple other organisations. This includes linkages to its various suppliers, competitors, and customers, technological infrastructures, professional networks and environments, etc. Influences extend beyond the immediate environment of innovating firms in space and time. A firm's innovation patterns is also a function of its expectations of

its neighbours' future behaviour, of customers, suppliers and competitors in particular.

These three general factors, innovation as a dynamic process involving mutual and multi-functional interactions with a varied, and organisationally structured, environment, have contributed significantly to the immense popularity of the term. The term is also extremely useful in policy formulation. Catching the systemic, inter-dependent character of innovation and technical change, the term proposes to encapsulate determinants of 'created' comparative advantages. However, it is worth emphasising that there is no system theory, or theories; an innovation systems perspective is only a suggestive perspective for outlining certain aspects of systemic or interactive innovation.

Though the literatures on the highly aggregated topic of economic evolution or structural change and those on the 'complex' world of firm-based competitiveness may seem universes apart, they are intimately linked. Understanding and bridging this 'micro-macro' chasm is still one of the fundamental challenges for social sciences. Innovation is regarded as furnishing at least the framework of one of these bridges; it is the accepted mode of describing both aggregate economic development and the formation of national and firm-level competitiveness. Innovation system approaches may contribute to an understanding of such processes and how the two world views interact.

Services in innovation systems

The residual of economic activities, conventionally denoted as services, encompasses integral parts of the history of industrial capitalism. Distributive and financial services play a constitutive role in the (first) industrial revolution. The professionalisation of technological and organisational development was an essential ingredient of the second industrial revolution. However, in the literatures on modern economic growth, there is an exclusive focus on productivity change in manufacturing industries. Service activities are generally left with a few passages, describing changes in aggregate sectoral composition of employment or output in the

post-war period. To the extent that service activities contribute to productivity growth, the verdict seems to be that they are peripheral productivity laggards.

This is evidently a gross misrepresentation of the role of services in economic systems; it should be clear that a simple dichotomy of manufacturing and services does not give fundamental insight into the dynamics underlying innovation and economic growth. Services are often conceptualised as parts of a 'structured environment', or as parts of a value chain, centring around a core of implicitly assumed manufacturing activities. These descriptions evidently capture some important 'industrialist' dimensions of the strong integration between several service and manufacturing functions. However, the fact that something like 75% of costs in manufacturing production and some similar share of employment is accounted for by service provision may be correct in an accountancy-based presentation of manufacturing production, but such numbers do not reflect the reality of such production. Rather than capturing the strong complementarities between these functions, these descriptions may create a false dichotomy between 'manufacturing' and 'services'. The failure of monolithic approaches to services is due to their failure to describe the fundamental heterogeneities of the economic role of different service functions. General questions of service innovation and service functions' impact on innovation in other sectors; for example, service functions' roles in innovation systems require a wider framework. But still the role of services in economic development and innovation processes, as well as the economics of several services themselves, is still little understood. Hence, we are not able at the present time to piece together a coherent picture. Hopefully, the outcome of the SI4S project will help to fill in a few more features of this picture.

Rather than trying to give a comprehensive description of such interactions, we will give a rather simple outline of some immediate roles played by prominent service functions in today's economic systems and in their historical development. Some services may have an immediate functional impact that directly affects innovation activities or selection of innovation projects. Others have functional impacts on innovation processes that are more indirect. We wish to make the following points;

- the generation of 'dynamic' externalities or spillovers relevant for innovation is wider than through 'blue print' innovations,

- the wider interactions and complementarities in a multi-functional economic system shape ranges of innovation opportunities,
- the outlining of structural characteristics of innovation systems is contingent on the purposes of the analyst or policy maker. Innovation policy objectives of economic efficiency and welfare generation and general criteria for innovation requires a different approach than a specific innovation firm-based analysis,
- when innovation related externalities and multiplicator effects are indirect, a sectoral approach allows a disentangling of policy analysis approaches to direct innovation capabilities in specific sectors. The Trans-European Networks initiative and the Framework Transport programme may be examples here; these economic infrastructures have an important role in enabling economy-wide economic efficiency, whereas the roles of such infrastructures towards specific innovation in user sectors are indirect and long term,
- in a general approach, there is an obvious role for functionalities and sectors in innovation systems, reflecting the evolving divisions of labour in the economic system,
- furthermore, in specific approaches, the immediate focus is on 'business environments' of firms and industries, where user-producer relations and more generally filière patterns feature prominently,
- the empirical questions we may raise about service functions' roles in innovation systems in the 'specific' approach are then two-fold,
  * to what extent are service related 'specific' innovation systems integrated into wider innovation systems, and more specifically
  * what is the involvement of wider knowledge infrastructures, in particular public technological or knowledge infrastructures in these innovation systems?

We will briefly illustrate some issues in the case of distribution services, before turning to what we see as the most significant ongoing trend in systemic innovation, the rise of a knowledge intensive economy.

Distribution services

The economic role of wholesale and retail trade and logistic and transport activities is rather immediate. Their basic role is to bridge a temporal and spatial gap between production and exchange. The role of distribution services in economic development is particularly elaborated in literatures on the industrial revolution. In Adam Smith's analysis in *Wealth of Nations* the commercial revolution of his day was a prerequisite

for the ensuing industrial revolution.[6] The development of trade and transportation increased reliability of distribution, improved time lags and reduced costs of arbitrage and distribution. The interaction of traders and customers enabled traders not only to exploit more and better information on location of demand for existing commodities, but also on how improved qualities of goods would satisfy related demands. The increased trading enabled by more efficient transportation and commercial systems had direct effects. By facilitating learning, the extension of markets reduced search costs, brought new options to producer's attention and increased the potential returns that could be appropriated from innovation. The integrated development of commercial trades and financial instruments and institutions alleviated risks and allowed the expansions of transactions.

Several more indirect effects have been discussed in the literatures, such as spill-over mechanisms related to engineering skills formation and to backward linkages, for example to the sophistication of intermediate demands, from transport sectors. Evidently, the growth of commercial trade and transportation has been a *sine qua non* for economic development over the last centuries. But claiming this does not amount to much more than stating the integrated character of the capitalist enterprise, important though it is. Causality is still an open question, whether the commercial development played an autonomous role or just reflected responses to changing demand for distribution services.

During these last 150 years several factors have contributed to a phenomenal increase in productivity in transportation. These have increased scope of transport services, allowed faster transport, as well as led to a substantial reduction in costs of distribution services which is an important ingredient in present globalisation trends. For all these, development of physical infrastructures were indispensable for realising productivity growth potentials. This is true even though individual drivers or originators may be identified in specific instances as in the case of aircraft; if the role of technological fascination is evident in the early history of aircraft, the development was quickly modulated by anticipation of commercial opportunities of aeroplanes.

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[6] In Wealth of Nations Adam Smith emphasises the continuity of economic development over the centuries preceding its publication; he is more concerned with his contemporary commercial

The productivity growth in transportation industries depended on technological development outside the sector itself; transportation needs have not 'created' aircraft and automobiles. But this does not mean that these activities were without influence in shaping these technologies, an influence that may be decisive. A rather obvious example here is the container revolution. The process of diffusion, adaptation and further development is an interactive process, with decisions about related infrastructures as additional prerequisites needed for this process to evolve. It is in the processes of continual adoption, adaptation and redefinition of inventions or technologies that their economic effects are generated.

This point is a general one, the economic significance is shaped in these 'subsequent improvements', processes that involve the network of distributors, producers, etc. In these processes the innovation systems approach is fruitful, as a conceptual framework for describing an interactive moulding of functional opportunities, market conditions and anticipation of demand patterns. Today several trends are visible. Vertical integration of distribution chains by manufacturers is a dominant pattern in car production. To the extent that such vertical integrations are on the increase, a relative marginalisation of extensive trade activities reflects enhanced opportunities for internalising transaction costs and positive externalities. On the other hand, the growth of third party logistics may be regarded as a new division of labour, with logistic operations being outsourced to specialised producers of transport and logistic services, as scheduling, route planning, transport and real time management of transport and terminal and storage services. The development of integrated transport systems facilitates the growth of new production modes, emphasizing flexible or just-in-time production. The integration of consumer goods production with mass marketing leads to the need of integrated and sophisticated distribution systems that allow fast and flexible distribution capacity. Large integrated distribution systems further emphasize the need for efficient large scale information processing, with increased application development in areas such as use of geographical information, tracking systems, and logistic system development. This gives additional impetus to the existence of efficient transport and information infrastructures, as is

revolution and it effects than the industrial revolution *per se* that ensued over the following decades.

acknowledged in the European Commission's initiative on Trans-European Networks.

The emergence of large retail and distribution groups in consumer goods markets, such as the US WalMart, the German Tengelmann, the French Carrefour and the Dutch Ahold groups integrates distribution, retail and marketing. A traditional structure based on large scale wholesalers with an independent and atomised retail system has been uprooted and is being replaced with an integrated system of actors that have challenged existing relations and distribution of critical expertise, as well as changing buying and consumption patterns. This has been coincident with the introduction of new chain concepts and sales formats in retail sectors over the last decades.

Service innovation systems

We may make a general and 'heroic' assessment that service related 'specific' innovation systems in general are only weakly integrated into wider innovation systems. This is an assessment that is tied up with several nuances and exceptions. However, three typical factors are suggestive of this;

- innovation, R&D and industrial analysis, widely interpreted, is very seldom organised activities at the firm level, except in very large and complex service organisations. In some service sectors, such as trade and financial services, industry-organised organisations and institutions with responsibilities of training, certification and industrial analysis form important intra-industrial knowledge and information infrastructures,
- the use of public innovation policy infrastructures is generally concentrated on a few service sectors, mostly technology- and knowledge intensive sectors, notably various business services,
- reflecting the multi-pronged objectives related to service infrastructures, or 'services of general economic interest', industrial policy has traditionally been institutionally segregated between industrial and functional policies and regulation on the one hand, and innovation oriented policies.

New modes of knowledge generation and distribution

With the survey of micro-level patterns of interaction of KIBS functions with their users or clients, given in the SI4S WP5/6 synthesis, Bilderbeek, den Hertog, Marklund and Miles 1998, we are in a better position to understand how the

distributed turnover of knowledge restructures national innovation systems. KIBS functions, increasingly institutionalised in specialised supplier firms, were characterised above as bridging institutions, attending to a distribution and transformation function of general, 'horizontal' knowledge into localised and specific contexts of 'vertical' knowledge and competencies. The consolidation of knowledge and capability formation as a significant factor of production further enriches processes of supplying KIBS services, with emerging knowledge markets that allow both specialisation and the attainment of scale economies, and by means of this exposes the potential supply of KIBS services to new types categories of firms and user organisations.

These new patterns of knowledge generation and distribution are not, however, a direct extension of the existing system. The phenomenon of emerging knowledge markets and of a new form of bridging institutions is both a symptom of and will in itself reinforce processes of qualitative change in innovation systems.

Antonelli argues (Antonelli 1998) that the organisation of knowledge production has evolved through four stylised modes since the industrial revolution;

- *entrepreneurship*, where acquisition of technological knowledge takes place by means of learning processes and personal creativity of entrepreneurs,
- *enforcement of institutional variety* through the increasing involvement of universities and a public infrastructure during the 19th century. The division of labour between the universities as knowledge producing institutions and firms as knowledge using institution is quite clear: universities generate technological externalities which firms absorb and translate into economic value,
- *vertical integration of knowledge production*, introduced around the turn of the century and becoming a dominant mode integrated with the rise of managerial capitalism and Mintzbergian techno-structures. Here firms develop in-house research centres and produce internally the new scientific and technological knowledge necessary to generate new product and process technologies. The issue of inseparability between production of knowledge and production of goods arises in this context. The interaction between the actual production process, the accumulation of tacit knowledge and the production of new technological knowledge, implemented by R&D activities, is essential to increase the productivity of research activities
- *technological co-operation*, a mode that has been increasing over the last two decades. The characters of the production process of new knowledge, such as significant economies of scale and scope, encourage firms to join forces and establish different forms of technological co-operation as a way of benefiting

from increasing returns, yet avoid transaction costs associated with the market exchange of new knowledge.

We are now witnessing an emerging mode of organisation of knowledge production, towards a progressive unbundling of the production of knowledge, through expertise specialisation and institutional creation of knowledge markets. Production of knowledge becomes the core activity of specialised firms whose product consists in new technological and scientific information that can be sold in the market place. This specialised new organisation of knowledge production represents a new mode that we hypothesise represents a core element of the learning knowledge economy.

The essential point here is that the reorganisation of knowledge production is associated with increasing appropriability of expertise and localised knowledge rather than the opposite. The nature of knowledge production changes character. Such a distributed production of knowledge generates forms of knowledge that are integrated composites of tacit and explicit expertise generated within differentiated contexts oriented towards and even constituted by areas of application.

Variants of this mode of knowledge production have been suggested earlier. Aspects of it are evident in Rothwell's 'fifth generation' innovation model (Rothwell 1992) as well as in the Mode 2 production of knowledge described by Gibbons and collaborators (Gibbons et al 1994). Callon has outlined a somewhat different variant; in his presentation, knowledge production is described as a 'privatising' capturing of knowledge production by techno-economic networks (Callon 1994).

It is nothing new that the mode of production of knowledge involves the joint production and use of tacit and explicit, or articulated, knowledge; more than thirty years ago, Polanyi stated that "all knowledge is either tacit or rooted in tacit knowledge" (Polanyi 1969). What this new mode leads us to emphasise is that for substantial parts of knowledge production in modern economies,

- knowledge production and distribution is distributed and involves distributed and localised contexts of application,
- the production structure evolves towards more distributed structures and institutions,
- however, enhanced information and network technologies may expand the sphere of influence, or 'market extension', of each producer,

- a closer alignment of specialised production and supply with expanding and differentiate demand patterns of potential client with opportunity, capability and willingness to buy,
- with such knowledge production and its frontiers being shaped by this market interaction in a fundamental way, as we have seen significant elements of distributed knowledge production is generated in the interaction process of clients and providers; it is generated 'on the market place',
- hence this mode involves new incentive structures and new 'agendas' of knowledge production, and implies rather different processes of quality control and cumulation of knowledge,
- lastly, it involves a diversity of new forms, new codification patterns, and bundling into other product markets of knowledge transmission or interaction, alongside with traditional modes of transmission/interaction.

As may been gleaned from these points, there may be a reorientation of conceptualisations of knowledge itself, away from the long-standing emphasis of scientific conceptualisation of knowledge.

The roles of KIBS in national innovation systems suggest that a 'new' knowledge infrastructure is in the making (ref. Bilderbeek, den Hertog, Marklund and Miles 1998), and is characterised by:

- a general blurring of boundaries between public and private realms as regards processes of knowledge transfer,
- a network of private and public institutions and agents generating and substantially paying attention to 'knowledge distribution',
- explicit attention to the diffusion and application of knowledge, supporting clients in their knowledge management,
- outsourcing and (reorganised) internalisation of knowledge intensive service functions by clients,
- organisations and agents marketing themselves as knowledge intensive services,
- services that are better attuned to the generally interactive nature of innovation processes,
- service professionals actively exchange knowledge and co-operate in networks.

The Fairy's Tool Box - Policy implications at European and national level

Innovation policy

Though it is usually stated there is (almost) no such thing as a service dimension to innovation policies, this 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 implies 'spill-over' effects on services since 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. Secondly, considering the concept of innovation policies beyond the limited context of direct innovation support policies, there is no doubt that these policies have significant effects on innovative performance involving services. It is an open question however how present innovation policies affect innovation processes in services.

A characteristic aspect of recent evolution of service sectors and their client sectors as regards their role in industrialised economies seems to be a dissolution of sectoral boundaries. In particular, the boundary between manufacturing and several service industries is becoming less important both from an industrial and a policy perspective. This emphasises the importance of reconsidering the role of industrially organised innovation policies. It is evident that the formulation of innovation and technology policies must take note of this, both in regard to their objectives of internationally competitiveness and their role in general 'welfare policies'.

The second aspect that we will raise is that innovation policies have, from the perspective of the policy maker, several objectives. Neither innovation policy or technology policy has any unique existence in policy organisation. Rather they must be regarded as aspects of wider policy areas, ranging from economic and financial policies, via industrial and regional policies, to social policies, contingent on an evolving 'division of labour' of the policy arena. As suggested by Bengt-Åke

Lundvall in the TSER report on the globalising learning economy, we may broadly distinguish between innovation policy as 'economic industrial policy', with a set of objectives related to industrial competitiveness and employment, and what he terms 'technology policy as sector policy', evidently emphasising the role of technology policy as an instrument to fulfil other policy objectives, and technology policy as a general concern in general industrial and economic policies. Using a traditional way of distinguishing science policies, we may distinguish between respectively 'innovation/technology in policy' and 'policy in technology/innovation' approaches.

Lundvall chooses to focus mainly on the 'policy in technology' approach, emphasising innovation and technology policies as 'economic policies'. It should be noted, however, that a 'policy in technology' approach also raises wider issues, relating to what we may term general 'welfare' policy objectives. Depending on the political and social climate in different countries and over time, the importance of the legitimisation, and operationalisation, of technology policy objectives may vary. A consequence of this would be the necessity of including learning, and its effects on policy formulation, by policy makers in analyses of technology policies and cross-national comparisons. Public concerns and political awareness of the role of technology development in shaping social development is well known, and impacts both directly and indirectly, through the social culture of policy formulating agencies, on the character of technology policy objectives, and on the shaping of individual technologies. We are not able to discuss these issues, but we will point to the importance of including also the 'demand-side' in the concerns of technology policies. This includes the role of educated and well-informed consumers, consumer and social interest group awareness, etc.

Thirdly, we point to the issue of a 'technological' approach of these policies. Evidently the issue at hand, in the technology/economic policy framework, is formulating policies that aim at supporting and modulating growth and development of firms and sectors. The main task is then to direct these policies towards the elements of these change processes that are important drivers and modulators for these processes. It is worth pointing out, even if it appears rather self-evident, the importance of interpreting the qualifier 'technological' in a wide sense, reflecting the diversity of factors that shape economic development.

Main policy issues of the SI4S project

We have in the preceding sections of this paper outlined the main conclusions and issues of the SI4S project,

- the need for a broader approach to innovation, where
- a dominant focus on technological innovation misses the significant role of 'soft', non-technological innovation in services,
- the importance of user-producer interactions,
- the more diffuse organisation of innovation in service firms implies that
- R&D and innovation support concepts applied to service innovation must necessarily be broader than the 'traditional' RTD based concepts
- the recent growth of KIBS services.

More specifically oriented towards innovation policy formulation, some of the basic issues identified are:

- Innovation policies must reflect the functional complementarities between service providing and service using sectors.
- Service functions are significant loci of learning and organisational flexibility in organisations; learning and organisational capabilities should be explicitly addressed in innovation policy formulation.
- Often operating on the interface between various industries, service structures may shape sectoral divisions and act as linkages across these. Identifying these type of service mediated processes should be a high policy priority.
- Recent developments have done much to improve the weaknesses of economic statistics, an important requisite for informed policy formulation, in describing service related economic evolution. However, considerable opportunities and challenges still remain, both in general economic statistics and in innovation related indicator development.
- Weak links between some service sectors and technological infrastructures also reflect an inappropriateness of these infrastructures towards the needs of service clients, as to both functional and firm characteristics. With a weaker intra-industrial organisation, industrial support systems are almost non-existent in several service industries.
- Regulation issues have been important for shaping of service industries. Service sectors have been deregulated and opened up for competition. This has exacerbated consequences in terms of skills requirements and structural changes in the composition of labour forces.
- Innovation systems are presently undergoing significant changes in the structure of knowledge generation. In particular KIBS services play important bridging roles in knowledge diffusion and formation of competencies. As yet this role is only weakly reflected in innovation policies.

- In particular these roles offer opportunities as important tools for developing technological infrastructure policies that reflect the needs of larger communities of firms and industries than traditional technological infrastructure policies.

More detailed policy issues are raised in the two work package synthesis reports, Sundbo and Gallouj 1998a and Bilderbeek, den Hertog, Marklund and Miles 1998. In the remainder of this section we will raise some broader aspects of these policy issues.

Services and European innovation policies[7]

In considering European level innovation policies, several issues are raised. A first set of issues are related to innovation policies in general, a second set to the European dimension of European these policies. Though these sets of issues are not mutually exclusive, the first set would include issues about the rationale, scope and scale of innovation 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 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 a consideration 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 used for public policy.

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7 This section is adapted from Hauknes and Miles 1996

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 innovation policy

Service sectors and firms are dominant in the European economy, in terms of employment and output. But they are relatively neglected in discussions of S&T policy. The issue of European competitiveness is usually seen as a matter that largely concerns manufacturing. This should be qualified however, for the reason that services do slip into the range of innovation policies 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 and related services in particular has been supported by programmes such as RACE, TELEMATICS 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 EU 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 EU 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 but 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.

- 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.

At both national and European level there are ongoing trends that signal an increasing focus of services in wider innovation policies. There is a long history for national and European telecom oriented S&T policies, shifting towards information society and information infrastructure related research and development, aiming also at developing arenas for the growth of competitive services based on ICT infrastructures. Transport and logistics technologies have in recent years become a prominent part of such policies. EU transport policies, and in particular the inclusion of Trans-European Networks objectives in the 1993 EU treaty, is a significant initiative in this respect. At a national level initiatives such as the German Dienstleistungen 2000 are evidence of an increasing focus of services. At the EU level recent and ongoing work has or is expected to have significant impact on the future shape of European service industries. Business services are increasingly seen as a key for industrial competitiveness. National initiatives like UK Link and European level programmes as MINT focus business services as extensions of a public infrastructure, and contributes thereby to a market generation for consultancy services. The Amsterdam Treaty and the ‘Putting Services to Work’ communication in 1996 was a precursor to several initiatives related to services.

From the evidence we have outlined above, one can conclude that there are a number of issues that are not addressed by the structural and regulatory initiatives. We are here thinking of challenges related to more direct, ‘hands on’ initiatives directed at the functioning and competitive and innovation capabilities of individual firms and

sectors. These issues, in line with the subsidiarity approach, probably address more directly national policies, rather than EU policies.

Over the last few years service innovation issues have increasingly been the focus of policy discourses, as indicated by the list of recent EU initiatives. This has happened at a time where trade organisations in various service industries have also become increasingly active and with a more aggressive public profile. The issues addressed concern first of all the need to develop an approach to innovation policies that reflects the characteristics of innovation in service firms, with a combination of instruments that reflect the firms targeted. The presence of active trade organisations and industrial fora in service industries would facilitate this adaptation process.

As noted the traditional basis for national innovation and technology policies only to a limited degree reflects the characteristics of innovation in most service firms, namely its soft character and the diffuse organisation. Including these characteristics explicitly in innovation policy formulation is a first need. A functional approach to service innovation offers in our understanding better opportunities for understanding the dynamics of service innovation.

As noted in Sundbo and Gallouj 1998a, we emphasise in particular the need to build up innovation capabilities in service firms. This includes innovation management in service firms, which fits closely with the present building up of service management as an area in European business schools. It includes training and professionalisation of service personnel and development of professional standards.

Services, Innovation, and Professionalisation

Services are much less liable to organise their innovation and technology development activities in the modes employed in manufacturing. 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 the 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 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.

Training and Education

A major impediment to service innovation is a lack of sufficient management capability to induce and carry through innovation processes in the single service firms and a lack of a learning system through which experiences in single firms could be transmitted to other firms so they could learn from them. Such a learning process could be across industry boarders. A means to improve these capabilities could be to focus on innovation management in business schools. Management of service firms has low priority in business schools and management of innovation in service firms is a non-existing discipline.

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 support 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.

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 ageing, 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. In several of these areas there is clearly a potentially significant role to be played by the informal service sectors, of non-profit foundations and voluntary organisations. If this potential is to be realised, the challenge may be more related to organisational and regulatory issues of how to let these kinds of organisations play a significant role and

to build up the necessary expertise and framework. There is a danger of seeking "technological fixes" - that is, of only looking for technological solutions to such 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. 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 be seized here.

Innovation policies 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 science and technology in future decades - problem fields such as those associated with ageing, security, etc. - the participation of relevant service organisations will be crucial. European programmes should thus seek both to turn to system-strengthening modes of operation, and explicitly incorporate services into these.

Distributed knowledge generation[8]

Until now, the economic importance of generic scientific knowledge as the unique result of formal R&D conducted in-house by firms and scientific activities conducted by universities, has been exaggerated. R&D expenditure as an adequate indicator of a firm's productivity performance is equally misguided. As a consequence too much emphasis has been put upon R&D policies and more generally science policies as the basic tools to sustain the rates of accumulation of new knowledge. Tacit knowledge, acquired by localised personal experience and individual learning processes, is also a major source of technological knowledge. In fact, many small firms generate significant innovations based mainly on tacit localised knowledge; and many larger firms actually fail in the diffusion of innovative initiatives in unrelated activities because of a lack of tacit-learning appropriation opportunities. There is thus a basic need for an economic environment which encourages the accumulation of such tacit knowledge and enables its interaction with the codified counterparts.

In the generation of new technological innovations, firms rely on external knowledge acquired by means of informal interactions between themselves, sharing learning opportunities and experience, and with other, established sources of knowledge and information and more formal processes of technological co-operation. Outsourcing of research activities and the procurement of knowledge intensive business services also play an increasing role in assessing the innovative capabilities of each firm. The levels of outsourcing of knowledge intensive business services should be accounted for when assessing the amount of inputs invested in the process of research and

[8] This section is partly based on Antonelli 1998a.

learning. The outsourcing of knowledge-intensive services could become an important recipient for policy interventions.

The innovative characteristics of the firm and the topology of the economic spaces into which it is embedded dictate the terms of communication and information exchange between firms, ultimately determining their innovative capabilities. We can identify three such 'architectural' factors in particular: the individual resources designated to the internal accumulation and implementation of tacit and codified knowledge; the receptivity to outside technological knowledge; and the connectivity and distribution network, in terms of knowledge, between firms. The quality of and accessibility to the information and communication technology infrastructure is also a significant indicator of an economy's innovative potential.

The topology of innovation systems and the quality of their communication networks can be greatly enhanced by the new key-sectors such as the knowledge intensive business services industries. The conditions of communication, dissemination, distribution, access and the quality of knowledge-intensive business service have important effects on the economic system in terms of innovative capacity. Countries with an advanced supply of knowledge intensive business services are likely to have stronger communication capability in terms of connectivity and receptivity levels and hence higher innovation capabilities. The services of consultants and advisers improve connectivity between agents, sharing learning experiences and creating learning opportunities, thus also enhancing receptivity. Similarly, advanced business services, in terms of distribution, competence and access, improve the interaction between tacit and codified knowledge, helping to introduce increasingly individual technological and organisational innovations. Such a dynamic situation can be of particular benefit to small- and medium-sized firms, compensating for the high costs of in-house R&D and the technological knowledge it helps generate.

More generally, traditional innovation policies based upon incentive schemes mainly designed to increase the levels of R&D could be reoriented in order to take into account the communication properties of innovation systems, such as connectivity and receptivity. Policies enhancing technological co-operation between firms and between firms and universities and specifically technological outsourcing are important in this context. Technological outsourcing may be promoted by active

demand and supply policies specifically designed to (1) favour the specialisation of firms in well defined technological niches, and (2) to foster the implementation of technological co-operation aimed at internalising technological externalities and increasing spatial stochastic interactions.

In relation to this rationale, property rights should also be re-assessed. The application of tight 'innovation oriented' intellectual property rights increases appropriation but is attended by a related reduction in the flow of communication between firms. An issue of under-utilisation arises with reference to the innovative capability of the network, with the existence of a clear trade-off between static and dynamic efficiency. Systems with 'diffusion oriented' property rights regimes have higher chances of stimulating the flow of technological communication between firms, and consequently obtaining higher rates of return from resources invested in innovation activities.

Advanced countries with well designed innovation systems are likely, over time, to experience a continual increase in innovative capability levels provided that positive feed-backs take place either 'spontaneously' or as a result of technology policies and strategies. Successful agents rooted within innovation systems can learn to communicate, in terms of both connectivity and receptivity, as soon as they realise that their innovation capability is positively influenced by the communication network and subsequently take advantage of increasing returns and positive feedback in learning both internal and external to each firm.

This entails a rather fundamental shift in the basis and rationales for innovation and technology policies. The dominant mode of policy formulation has been in terms of design supply functions, where the main challenge of policy formulation has been to identify key areas for the development of strategic technology inputs to business sectors. The ongoing reorganisation of knowledge generation to a distributed production system around markets for knowledge makes life easier for public policy makers, and more difficult at the same time. Things are simpler in that there is an emancipation from the market failure rationales of innovation and R&D policies, with the conflation of the objectives of public policies with a fictitious benchmark of perfectly functioning markets. They contribute to a clearer demarcation of public and private objectives of innovation policies.

On the other hand these challenges make policy formulation more difficult. The innovation policy challenges are clearly much more indirectly related to the actual unfolding of industrial innovation. Policy objectives will be more open-ended and framework enabling than oriented towards specific technological or economic objectives, with three core areas of policy formulation.

First, public policy should ensure the distributive capacities of broader innovation systems, both in terms of material and immaterial infrastructures and in terms of counteracting tendencies to locking in of knowledge markets on specific techno-economic objectives. This also includes facilitating extension and entry of these production and distribution systems into economic areas outside those 'high tech' areas that dominate the present developments.

Furthermore, an essential element of the new production mode is the building up of systematic absorption capacities of client firms. Public policy has an obvious role in enabling this process of professionalising potential users that face barrier costs or attention barriers, notably for firms and sectors where conditions for linking up with the new production system are weakly developed. This would seem particularly relevant for certain categories of SMEs. This regards development of in-house capabilities to utilise the distributed production system, as well as capabilities to assess and evaluate services offered on the market.

A pertinent issue here is the need for formal and informal standardisation, certification etc. Public policy should include some aspect of regulation; in some cases, it may still be necessary for public regulation and certification, through educational requirements and otherwise. In other cases a more appropriate role is to enable development and proficiency of industrial and professional networks and organisations.

Thirdly, a core area will be to ensure flexible interaction of the distributed system of knowledge producers and the public system of universities and other scientific institutions, institutions of higher education and so on, to allow a sound division of labour. This does not imply a tightening of the requirements of user orientation and industrial needs of academic institutions. Such responsiveness is well developed in a few industrial areas, with well-forged links between academia and industry, most

notably in the pharmaceutical industry and micro-biology based production, as well as between the geo-physical sciences and geological surveying and petroleum exploration. The point is that there are several specific factors of each of these connecting institutions; these are not role models that can be applied generally for academia-industry links.

It is important to emphasise the mutual and reinforcing advantages in allowing a complementary rather than a collateral division of labour emerge. Though conditions would vary, a measure that would enrich interactions as well as enhance the benefits and network building effects from the education objectives of academic institutions, is dual and mixed careers.

A further case may be raised in the role of public policy and policy agencies as market makers and mediators. This role has been taken up to some degree in the use of 'innovation agents' in public innovation policy programmes (see Bessant and Rush 1998). However, we may also envisage a wider role given the accepted legitimacy and independence of public agencies, in terms of advising, mediating and 'broking' between KIBS producers and users.

In terms of institutional sectors, the challenges these trends raise are probably largest for public or semi-public R&D infrastructures that are organised or substantially funded from public sources to serve industrial innovation. Examples here are the Dutch TNO and the Finnish VTT organisations, Norwegian industrial R&D institutes, as well as to some extent the German Fraunhofer institutions and French/Italian style research council based organisations. These institutions may increasingly find themselves in a situation where they may be criticised for subsidised activity in competition with the new market actors. For several organisations of this type, a rationale alternative would probably be to enforce the institution's role in developing a general scientific knowledge infrastructure, on par with the role of academic institutions. On the other hand, institutions such as these are large enough to be able to shape the knowledge 'industries' and markets themselves. It is obvious that the responsibilities this implies for public policies in surveying and assessment are many and complex.

We do not envisage a wholesale shift in restructuring of public policies; this will probably be a gradual process. Furthermore, as with the former shifts in emphasis of innovation policies, there will be layers of sedimentation with new and former approaches and modes of knowledge production. However, even a partial development along the lines we have suggested here implies the need for a rethinking of rationales and implementation strategies for public innovation policies.

Documentation and statistics

Economic statistics and data

A part of the SI4S project involved an attempt to map and analyse in a comparative framework the position and role of various services sectors in European countries. In the report of this work, *Services in Europe – Patterns of growth and development*, Preissl 1997, it is noted that the lack of comparative statistics at a sufficiently disaggregated level proved to be a serious impediment to the possibility of a considerate comparative analysis of structural change. It was noted that the growing importance of services is not reflected in statistical documentation of the sector's activities. Classifications and categorisations used in most statistical information are not adequate to show the growing importance of new services like those based on information and communication technology or business services. Furthermore, each country uses her own classification. Thus, for many subsectors data are not directly comparable between countries and cannot be aggregated. In addition, classification schemes differ between national account statistics, EUROSTAT publications and OECD statistics. In general, service statistics do not in any way reflect the diversity and the impact of changes in the sector in the last decades.

The most comprehensive data base (with respect to comparable classifications, coverage of countries and time series), OECD National Accounts and OECD Services Statistics, presents an ISIC-based, rather highly aggregated scheme for data on services. A more detailed classification is essential with respect to the dynamics of innovation in the sector. In the widely used ISIC or VAT-classifications, even the most detailed subgroups comprise quite heterogeneous activities. Unfortunately, service statistics do not allow analysis of the development of KIBS services on a

comparative basis for all European countries. Similarly, shifts in the importance or weight of service subsectors, which derive from the increasing use of information and communication technology, cannot be observed in most countries' statistical accounts.

Attempts to construct a consistent data base on services using the NACE classifications, which have been harmonised among European countries, have been initiated by EUROSTAT. The very detailed NACE Rev.1 schemes which try to take into consideration the evolution of services over the last decades in terms of technical progress, division of labour and dynamics of growth, will allow for more appropriate analyses, once the respective data have been collected. However, procedures in the Member States still have not advanced beyond an adjustment of definitions and classifications, and only a few pilot projects and unrepresentative pre-test surveys for specific subsectors have been conducted in a small number of countries so far. It will probably take another decade until a reasonably complete data set on services for Europe can be obtained from EUROSTAT's initiatives. Since many countries are in the process of reorganising and improving their service statistics, comparability over time is often not guaranteed. Thus, an analysis of growth and structural change in the services sectors of EU countries that go beyond the highly aggregated OECD data, has to be based on pieces of often inconsistent data derived from various national and international sources

A huge problem in international comparisons and in time series analysis is deflation. Not only do some countries not provide any data in constant prices, but in addition the available data cannot be used for comparison because different basis years are adopted, and basis years change at different points in time for different countries. Since for most service categories there is not enough information about the structural composition of subsectors and about the structural distribution of changes in price within these subsectors, it is not even possible to adjust basis years to the desired degree of exactness.

This raises three issues;

- the need of a rapid implementation of detailed sectoral, product and occupations classifications in a way that ensures trans-national comparability,

- the need for comparative refining and presentation of historical data to allow consistent time series analysis,
- the need to look forward to next generation statistical standards and classifications.

Innovation measurement and statistics

More specifically regarding innovation statistics, the CIS round will probably furnish valuable data on innovation in services, with added comparability to manufacturing. However, the CIS II approach is only a step towards a fuller and better mapping of innovation activities in services, as well as manufacturing. What the measurement challenges could be are outlined in the following table, distinguishing two approaches; of a sharp demarcation of service innovation from manufacturing innovation, contrasted to an approach emphasising that 'servicing' dimensions increasingly raise issues that are relevant for all sectors. A systematic evaluation of the CIS II exercise would provide valuable inputs into the planning and design phase of a potential third round of CIS.

Table 9: Implications of two approaches for innovation measurement. Source Coombs and Miles 1998

Measure-ment challenges	**Sharp demarcation**	**Rainbow economy**
Concepts of R&D and Innovation	Problems specific to measurement in services. Conventional terminology inappropriate to and unrecognised by many services. Important role of organisational innovations, yet these remain poorly measured in received approaches.	Problems impact across all economy, though often particularly intense in service sectors. Organisation of firms in all sectors is such that innovative activities in marketing, distribution etc. are often not under purview of R&D managers, thus liable to be overlooked in surveys etc (and in firms' own strategic planning?)
Definition of R&D	Term not seen as appropriate even in many technology-intensive services (despite Frascati modification to include software). Role of customisation much more ambiguous than Frascati manual implies.	Need a new concept of 'investment in innovative activities' (defined as having the intention of altering the nature of the market offering of the enterprise, or of its underlying costs of doing business)
Definition of innovation	The term "innovation" is not recognised at all by managers in some countries (but substitutes like "something new" are too all-encompassing?). Product-process distinction liable to be misleading at best when it comes to delivery and other interactional innovations. Organisational innovation seems critical in many services, but is hard to quantify.	Need to distinguish among various (material and immaterial) changes which can occur in either 'sector'. Material changes may then largely be classified as standard into product, process (and delivery?) etc. Immaterial changes could productively be divided into those 'focused on client relationships' or 'focused on internal processes', with subcategories of each (e.g. transactions, product tracking, etc.)

Location of innovation	Innovations co-produced with clients may be attributed solely to the latter.	Innovative activity seen as intrinsically structured as 'participating in a process located in a network', usually not closely bound to one 'innovator'
Organisation of innovation	Project rather than R&D management may require different respondents	Innovative activity diffused among functional units of firms
Distributed innovation processes	Only capable of being demonstrated through complex input-output analysis.	Networks vital: problems in identifying and measuring network level innovation (large technical systems and co-ordinated introduction of standards and peripherals, as well as collaborative innovative efforts in R&D etc.)
Economic effects of innovation	Difficult to trace because of inter-sectoral flows.	Sectors become less important than chains and networks. The location of innovation also becomes the natural location for the identification of economic data
Implicit underlying under-standing of innovation	New material artefacts which happen to consume immaterial inputs in their production	Entrepreneurial acts by firms which change existing market relationships. These may or may not involve material novelties.

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Appendix 1: The SI4S project outline

OBJECTIVES

The SI4S proceeded via a series of workpackages to examine the role of services as users, originators, modulators and agents of transfer of innovations. The programme was organised around *innovation in services* and *services in innovation*. These two aspects consider the two roles of service activities towards innovation dynamics; as a site of or significant user of innovations, or as a "catalyst" of innovation processes in networks with other economic sectors. From this starting point the objectives of the SI4S programme were twofold;

* to map, understand and analyse the changing role of services and service innovations as users, carriers, shapers and sources of innovations in European innovation systems,
* to design, formulate and integrate options for innovation and technology policies and business strategies that take into account the role of services in innovation and innovation in services.

ORGANISATION OF THE SI4S PROJECT

The questions we have covered include,

- mapping the structural dynamics involving business services with particular emphasis on their role in innovation and other change processes,
- role of business services and especially knowledge intensive business services as 'diffusion agents' of new knowledge towards both manufacturing and service sectors,
- the interrelations between internal and external service provision to business firms, and innovative capabilities,
- innovation management and strategies and role of knowledge related complementary assets in service firms,
- appropriability regimes of service innovations,
- the role of regulatory frameworks for service innovations,
- service functions and their links to knowledge infrastructures and R&D and innovation policies.

Within the framework of SI4S services innovation was studied from three perspectives:

- statistical description and analysis of services development at a macro level,
- studies of innovation and the shaping of innovation processes in services at both the macro and micro-level,
- studies of services in innovation services i.e. the development of a specific group of services (KIBS) and especially their contribution to innovation processes in a range of service and manufacturing industries.

The project was organised around six substantial work packages, where WP 3 and 4 on innovation in services and WP 5 and 6 on services in innovation respectively were integrated into the strands WP3/4 and WP5/6, cf. Sundbo and Gallouj 1998a and Bilderbeek, den Hertog, Marklund and Miles 1998,

WP 2 Services in the economy aimed at giving the broad picture of and analysing the macroeconomic roles of service sectors and their related development and dynamism. The main outcomes of WP2 were a state of art report on innovation and services, contributed by the project coordinator Johan Hauknes, and a report giving a statistical overview and analysis of services in European economies, written by Brigitte Preissl.
WP 3/4 Innovation in services has studied and characterised innovation processes in service sectors as well as mapping the level and organisation of innovative activities in the selected service functions, giving a broad basis for development of innovation concepts. The SI4S synthesis report 2, Sundbo and Gallouj 1998a describes the main outcomes and analyses of the strand.
WP 5/6 Services in innovation has analysed aspects of the role of business services in innovation and other change processes in a range of industries by mapping and analysing the role and contribution of services in innovation processes across their clients' and suppliers' value chains. The main results and conclusions are described in the SI4S synthesis report 3, Bilderbeek, den Hertog, Marklund and Miles 1998.
The objective of *WP 7 Synthesis and policy conclusions* was to give an analytical synthesis of the SI4S project and its results and develop implications from this for

- national and European innovation policies,
- business strategies,
- future research on these issues and
- future development of innovation data gathering procedures and indicators.

The main outcome of this work package is the present synthesis report.

Appendix 2: The SI4S consortium

The SI4S project is run by a research consortium of nine research institutions in nine European countries. The project has been funded by the European Commission through the Targeted Socio-Economic Research programme under contract ERB-SOE1-CT-96-1015, partly funded by national sources in the participating countries. The eleven contract signing partners with the main researcher are

The coordinating institution

* Stiftelsen Studies in Technology, innovation and Economic Policy (STEP Group), Oslo, Norway, senior researcher Johan Hauknes. Johan Hauknes has also been the coordinator of the SI4S project.

The project partner institutions were

* Centro di Studi sui Sistemi (CSS), Torino, Italy, professor Cristiano Antonelli
* Deutsches Institut für Wirtschaftsforschung (DIW), Berlin, Germany, senior researcher Brigitte Preissl
* Institute Federatif de Recherche sur les Economies et les Societes Industrielles, (CNRS/IFRESI), Lille, France, associate professor Faïz Gallouj
* Κεντρο Οικονομικης και Περιβαλλοντικης Ερευνας και Στρατηγικης (ΚΟ ΠΕΣ) [Center for Economic Research and Environmental Strategy (CERES)], Athens, Greece, professor Yannis Katsoulacos
* Näringsutvecklingsverket (NUTEK), Stockholm, Sweden, chief analyst Göran Marklund
* Policy Research in Engineering, Science and Technology (PREST), Victoria University of Manchester, Manchester, United Kingdom, professor Ian Miles
* Roskilde Universitetscenter (RUC), Roskilde, Denmark, professor Jon Sundbo
* TNO Studiecentrum voor Technologie en Beleid (TNO-STB), Appeldoorn, the Netherlands, senior researcher Rob Bilderbeek and senior researcher Pim den Hertog

The consortium has also included two major subcontractors,

* Dansk Teknologisk Institut (DTI), Copenhagen, Denmark, director Peter Plougman
* Centre for Research in Innovation Management (CENTRIM), University of Brighton, Brighton, United Kingdom, senior researcher Mike Hales

Appendix 3: Reports, notes and publications from the SI4S project

SI4S Synthesis Reports

Johan Hauknes 1998, **Services in innovation - Innovation in services - SI4S Final report**, *SI4S Synthesis Report 1* (This report)

Jon Sundbo and Faïz Gallouj 1998, **Innovation in services - SI4S Project synthesis Work package 3/4**, *SI4S Synthesis Report 2*

Rob Bilderbeek, Pim den Hertog, Göran Marklund and Ian Miles 1998, **Services in innovation: Knowledge intensive business bervices (KIBS) as co-producers of innovation**, *SI4S Synthesis Report 3*

SI4S Topical Paper series

1 Innovation in services

Innovation in services – Barriers and organisation

SI4S TP 01 *Faïz Gallouj,* **Innovation in services and the attendant myths,** *IFRESI*

SI4S TP 02 *Brigitte Preissl,* **Barriers to innovation in services,** *DIW*

SI4S TP 03 *Jon Sundbo,* **Standardisation vs. customisation in services,** *RUC*

Innovation trajectories

SI4S TP 04 *Jon Sundbo and Faïz Gallouj,* **Innovation as a loosely coupled system in services,** *RUC, IFRESI*

SI4S TP 05 *Faïz Gallouj,* **Innovating in reverse: Services and the reverse product cycle,** *IFRESI*

SI4S TP 06 *Brigitte Preissl,* **Innovation in services in Germany: A question of "mentality"?** *DIW*

SI4S TP 07 *Finn Ørstavik,* **Innovation regimes and trajectories in goods transport** *STEP*

SI4S TP 08 *Cristiano Antonelli,* **New information technology and the knowledge-based economy. The European evidence,** *CSS*

SI4S TP 09 *Göran Marklund,* **Need for new measures of innovation in services,** *NUTEK*

2 KIBS patterns in innovation

KIBS growth and dynamics: A cross-country perspective

SI4S TP 10 *Paul Windrum and Mark Tomlinson,* **The impact of KIBS on international competitiveness: A UK-Netherlands comparison,** *PREST*

The KIBS firm and its interfaces

SI4S TP 11 *Pim den Hertog and Rob Bilderbeek,* **Conceptualising (service) innovation and the knowledge flows between KIBS and their clients,** *Dialogic/TNO*

SI4S TP 12 *Erland Skogli,* **Offshore engineering, consulting and innovation**, *STEP*

SI4S TP 13 *Mike Hales,* **A tale of two sectors – Issues in the mapping of knowledge intensive business services,** *CENTRIM*

3 Perspectives on knowledge infrastructures

SI4S TP 14 *Pim den Hertog and Rob Bilderbeek,* **The new knowledge infrastructure: The role of technology-based knowledge-intensive business services in national innovation systems,** *Dialogic/TNO*

SI4S TP 15 *Cristiano Antonelli, T***he evolution of the industrial organisation of the production of knowledge,** *CSS*

SI4S TP 16 *Yannis Katsoulacos and Nicholaos Tsounis,* **Case study on sectoral research institutes as providers of T-KIBS in Greek manufacture** *CERES*

SI4S Articles Series

These articles will be published by Pinter Publishers as the volume **Services, innovation and the knowledge based economy** in 1998.

	Title	*Authors*	*Institution*
1	**Are Services Special?**	*Ian Miles and Mark Boden*	*PREST*
2	**Neo-Schumpeterian Perspectives on Innovation in Services: A survey**	*Camal Gallouj and Faïz Gallouj*	*IFRESI-CNRS*
3	**Dynamic Innovation Systems: Do Services have a Role to Play?**	*Johan Hauknes*	*STEP Group*
4	**European Services in Comparison**	*Brigitte Preissl*	*DIW*
5	**Indicators of Innovation Activities in Services**	*Göran Marklund*	*NUTEK*
6	**Organisation and Innovation Strategy in Services**	*Jon Sundbo*	*Roskilde*
7	**Beyond Technological Innovation: Trajectories and Varieties of Services**	*Faïz Gallouj*	*IFRESI*
8	**Supplier-User Interaction in Knowledge-Intensive Business Services: Types of Expertise and Modes of Organisation**	*Jacob Norvig Larsen*	*Roskilde*
9	**Innovation Agents and Technology Transfer**	*John Bessant and Howard Rush*	*CENTRIM*
10	**Localized Technological Change, New Information Technology and The Knowledge-Based Economy: The European Evidence**	*Cristiano Antonelli*	*CSS*
11	**Knowledge Intensive Business Services and Productivity Growth: The Greek Evidence**	*Yannis Katsoulacos and Nicholas Tsounis*	*CERES*
12	**Information and technology flows from the service sector: a UK-Japan comparison**	*Mark Tomlinson*	*PREST*
13	**The New Knowledge Infrastructure: The Role of Technology-Based Knowledge-Intensive Business Services in National Innovation Systems**	*Pim den Hertog and Rob Bilderbeek*	*TNO*
14	**Conclusions: Beyond the Service Economy**	*Ian Miles and Mark Boden*	*PREST*

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STEP group

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 innovasjonspolitikk 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.