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Innovation in the Service Economy

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Preamble

"The recognition of the role of the service sectors
in the innovative process
is a major shift in official thinking
and one that has been long overdue...
the structure of the service sectors
and their institutional settings
have a powerful influence
on a country's technological activity."
Richard Freeman,
Innovation and Foresight
Office of Science and Technology (HMSO),
London 1994

This report is the first outcome of a European research project supported by the European Commission through the *Targetted Socio-Economic Research* programme (TSER). The first part of the project Services in Innovation - Innovation in Services, SI4S, was designed to give an overview and discussion of central parts of the literature relating to central issues that was raised in the SI4S research programme. The report is authored by the coordinating institution of the SI4S project, but has benefited from substantial inputs and from discussions with the other participating institutions and researchers. It is easy to acknowledge these inputs.

The main theme of this report - *innovation processes in services* - is a fascinating and stimulating subject, as well as a subject of vital importance to innovation studies in general, with implications for the overall development of industrial innovation policies. We are grateful to the European Commission for supporting our activities in this field and for allowing us to direct significantly more resources to this area than would otherwise be possible.

The objective of the first part of the project has been to give a topical presentation of the research literatures on service innovation. This is a topic of central importance to all advanced economies given the interrelations between growth in services and structural changes in national economies. The development of service, information or knowledge societies is a process that in terms of social impact may be comparable to the emergence of industrial society during the nineteenth century: the emergence of service economies seems to be changing the fabric of the social and economic systems. The common perception of modern service societies as dominated by hair dressing and hamburger flipping completely obscures the dynamism and complexity of the emergent service economy. The main aim of the present survey is to describe and discuss issues that are related to the diversity and complexity of the service

economy and its current contributions to innovation and growth. By doing this we hope to be able to attain a better understanding of the processes behind recent developments and of the factors that are contributing to the moulding of future developments.

However at this stage we may already identify one factor that seriously limits understanding of such changes. It is quite surprising that with a few notable exceptions, the focus on innovation processes and productivity change in service sectors has been marginal, when compared to the literatures on similar issues in manufacturing industries. Similarly a systematic investigation of the interrelations between evolving service industries and other economic sectors is notable by its absence in the present framework of innovation analysis. This creates serious hindrances to understanding change processes that involve these. Hence the interaction between services and other sectors should be a significant priority in future innovation and industrial research.

In approaching the topic of service economies we make a few basic assumptions; assumptions that find confirmation in the available literatures and data. First, to implement innovation policies requires a thorough understanding of the characteristics of innovation at firm and industry level. This involves understanding processes of technological change, opportunities for development and use of new technologies and services, as well as the role of specialised expertise and changes in social structures.

Secondly, we believe that there are significant and wide-ranging innovation activities in service industries. The growth of several service sectors, development of new services and increased internationalisation and deregulation of service sectors, suggest that these processes are increasing in scope and intensity. The growth of some services is associated with standardisation, suggesting processes that resemble the industrialisation processes that changed the mechanical arts into the modern manufacturing industry. For other services, the process is towards increased complexity and customisation, a process finding parallels in the development of several manufacturing industries.

There is a possibility that ‘peculiarities’ of services may have a decisive impact on innovation processes in services. It is necessary, therefore, to widen the traditional scope of innovation studies in manufacturing sectors, to include other types of innovation processes. Though the share of ‘non-technological’ innovations may be larger, these non-technological innovations have strong links to technological change. Service innovation may further raise the need of developing new innovation typologies; uncritically adopting the conceptual framework of manufacturing innovation may lead to a misrepresentation of service innovation, and hence of innovative performance in general.

The last assumption is that the development of modern societies is a complex process involving a wide range of interrelations between economic and social factors. More specifically we assume that innovation processes in service industries can only be understood if we include in the analysis the complex relations between these and other economic sectors; including, but not limited to, manufacturing industries. An

implication of this is that some services will also be central determinants of innovation processes in manufacturing industries.

Of the issues we have considered in the present work we will here point to

- to what extent are 'peculiarities' of services determining factors of innovation and productivity increases in services?
- what are the main structures of service innovations? And more particularly - what role does R&D play in these?
- are there processes of emerging industrialisation in services?
- what are the appropriability regimes for innovation in services, and are there appropriability regimes that are specific to services?

as topics that form central parts of our work in this area. Within the STEP Group service related activities are organised as a broad program area, *Services in innovation systems*, with the prime objective of generating knowledge of services' roles in economic growth and development in advanced economies. The program areas has as its objective to generate knowledge of and contribute to an enhanced understanding of innovation and economic change in a service economy, and to facilitate use of this knowledge in public policy making concerned with developing industrial policies that reflect structural and sectoral characteristics of advanced economies. It is furthermore our aim that this work will prove valuable to service providing and service using companies in pointing to systematic frameworks and approaches for identifying strategic choice possibilities for innovation and development of profitable commercial consepts.

Central in this program area will be our coordination of and participation in the SI4S project, and our activities for the Norwegian Service program TYIN. In addition our activities will be based on STEP-funded projects and initiatives. This has allowed us to develop an integrated research program on service related issues; a program where we can optimise synergies between the various project activities, funding institutions and interests related to these activities.

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I Services and the economy

Introduction

Service activities have a central role in the integrated interplay that constitutes advanced economies. Not the least, this applies to the role service functions play in generating innovative commercial areas and functions, new service products, and in developing possibilities for innovative activities in other sectors of these economies. Service functions have a substantial, yet underfocused, role in processes of structural change in all industrialised countries, and they are therefore also shaping the furhter development of these economies.

Hence, the fact that our understanding of how innovation is generated and developed in service production and of how the complementary interplay between service and manufacturing activities shapes both of them is weak, is a paradox. This is particularly a problem for public policies that aim at enabling and strengthening profitability and competitiveness of national industries. It is a paradox that industrial policies that have a goal of improving innovativeness of the private sector; innovation and technology policies, only to a small degree have considered sectors that form an important part of the economies.

Formulation of public innovation policies is not primarily a question of setting general objectives that covers all industrial activities. The most important question that faces policy makers in this area is the design of operative policies, policy instruments support schemes and other initiatives that meets the challenges that different industrial activities face, taking serious account for the complementarities between these challenges. That these challenges show considerable variations and specificities across industries, is amply shown by a wide range innovation studies in manufacturing industries. There are no reasons to expect that these variations are less for service industries, and the complexity of the issue may increase even more when the integrated character of the interplay between industries is included.

The lacking attention of service industries in public innovation policies is increasingly being focused in individual countries, and in international organisations like OECD and the European Union. Increasingly the attention is drawn to the consequences of a weak basis of knowledge and understanding, and towards a greater need of developing initiatives and instruments that also encompass characteristics of service functions. This increased focus leads to an enhanced attention to the interplay between sectors and functions, leading to questions of how well existing instruments are adapted to the systemis interactions within the economic system, and if the concepts describing innovation processes, and the concomitant interpretation of them, that underpin these policies are misleading.

This reorientation of public innovation policies immediately raises a series of questions that cannot be answered today. Here we will emphasises the need for

- mapping and analysing innovation processes in several service sectors and functions, as to the relation and differences between technological and non-technological innovation, to integrated innovation processes across sectors and functions, and to the economic effects of innovative activities. There is a further need for knowledge of how innovation processes are initiated and developed,
- knowledge of innovation strategies, variations in characteristics of these across sectors and functions, and organisation of innovation processes,
- understanding of what mechanisms that are available to ensure econom,ic benefits of innovative activities for different service functions, and the functionality of these mechanisms,
- knowledge of how service activities interact with technological infrastructures, such as universities, R&D institutions, public advisory services etc., and of the interaction between these links and innovation processes within individual firms,
- an understanding of how service firms affect innovation activities in other sectors and firsm, directly and indirectly. More specifically, the question may be raised of what the importance of the evident knowledge generating and transferring role of knowledge intensive services.

The present report is an attempt to elicit where we stand in answering such questions. The hope is that this section, together with the following ones, will point to possible directions for future research and to focussing policy attention to industrial activities that are vital to the future development of our societies.

1 Introduction

The two first chapters will give a broad overview of the main issues that are considered in this report. They may be read as a summary of the whole report, but without the detail behind some of of the claims that are made here. But as the reader of the main text will discover, for some of the claims we can only offer suggestive arguments.

1.1 Service growth

For a short moment, think back 30 years, to 1965: before the OPEC actions in 1973, before the invasion in Prague August 1968 and the hot summer in Paris the same year. The Bretton Wood agreement is still a reality. Student enrolment have exploded over the last 10 years. De-industrialisation is not yet invented. The industrial policies of the 1950s have been crowned with success; the 1960s were the days of Galbraith's affluent neo-industrial society (Galbraith 1967) - it was 'full speed ahead'. The secondary sectors; the 'hard' industries, were at the peak of political interest, sectors that still retained the smoke-stack heritage, but increasingly showed prospects of a different future, not the least from the new-born micro-electronics industry and the space programmes.

What tendencies contemporary observers identified as the seed of a new era differed, although a common thread was the future role of scientific and technical knowledge and rationality. Galbraith, in emphasising the emergence of large scale knowledge intensive manufacturing industries and of new productive structures with access to strategic knowledge and technology, was primarily focusing the restructuring of the industrial sphere, and a complementary restructuring of the relation between the industrial sector and public authorities. Galbraith's focus of attention was the large corporations; these carried the seed, through their greater abilities to take opportunity of scientific and technological progress, to a growth of science-based manufacturing industries. While Galbraith's approach is often referred to as 'neo-industrial', Daniel Bell chose the concept of a 'post-industrial' society (Bell 1973) as epitomising the role of knowledge production as a determinant for new social relations. Theoretical knowledge was the 'axial principle' of the post-industrial society. This would have wide repercussions on society; the society would become 'sociologising', rather than 'economising'. Both sprang out of US traditions; Galbraith with industrial economics as background, Bell with sociology as the reference frame. But in contrast to Galbraith's book, Bell's is today part of an expanding literature on knowledge or information societies. Nico Stehr reviews several of the analytical approaches to the shift, and shows that this was a wave involving many different intellectual traditions (Stehr 1994).

In a contrast to such 'grand theories', observers like Colin Clark (Clark 1957) a decade earlier, and Victor Fuchs (Fuchs 1968) were concerned with identifying the changes that were occurring in western economies, and with understanding the underpinnings of these developments. From the vantage point of long term economic development, they were concerned with the shortcomings of existing economic theory

in explaining central e features of modern economies that were subsumed under the concept of 'tertiarisation'; that the 'tertiary' sectors, *viz.* non-primary and non-secondary sectors, represented the largest share of employment in the industrialised economies, a share that was increasing fast. The growth of service employment was, perhaps paradoxically, a central characteristic of the modern industrial countries. In particular, following Fritz Machlup's quantification of 'knowledge' production and distribution (Machlup 1962), functions and sectors generating and furnishing information and knowledgeemerged as a central feature.

The developments in the 30 years that have passed have emphasised the common elements of these approaches. In spite of the lack of consensus about the appearances of the processes, the idea of a transition of the industrialised countries into complex 'service-based' economies and emergence of knowledge-based economies is shared by all. Today roughly 2/3 of employment are in the tertiary sectors in most OECD countries. While the total OECD employment in wholesale and retail trade and hotels and restaurants was larger than the employment in manufacturing industries in 1990, the employment in financial and business services (FIRB - finance, insurance, real estate and business services) was almost 25% larger than the employment in manufacturing of machinery and metal products, including car and IT industries. Employment in social and governmental services corresponds respectively to about 2/3 and 3/4 of the total manufacturing employment. While manufacturing employment fell by 0,5 million from 1989 to 1990 in the OECD-countries, this was outpaced five times by employment growth of nearly 2,5 millions in market services.

We will not give any detailed description of the changes of the modern economy, but let us just illustrate the transformation with four indicators.

i) In the sectoral pattern of employment growth in OECD countries from 1970 to 1993, one sector is prominent (see Figure 1.1). 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. Two characteristics of the changes seem to suggest themselves; the emergence of the modern welfare state and a 'complexification' of business activities with a strong hi-tech flavour.

   The sectors with the largest decline in employment are primarily low- and medium-tech industries. As there has been a skewed productivity development over this period; with high productivity growth in the hi-tech end of the spectrum of manufacturing activities and slower growth in some industries at the low tech end, the conclusion must be that the character of the overall production has changed dramatically over the period.

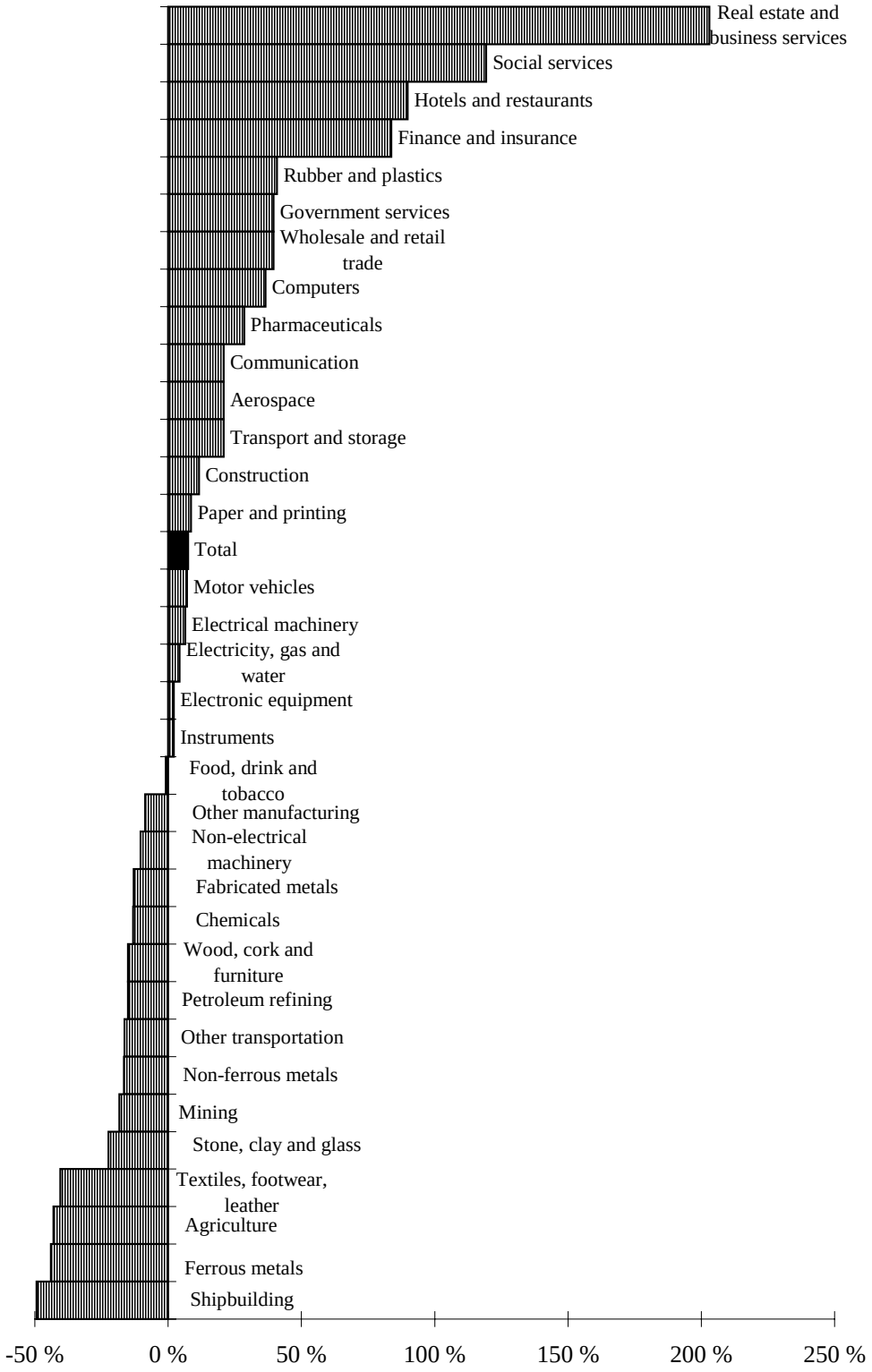

Figure 1.1 Total sectoral employment growth in OECD 1970-1993. Percent growth over period. Source OECD 1996a
For a number of industries, the OECD total is an estimate based on less then 25 countries.

ii) This is also reflected in changes in the composition of the labour force in some OECD-countries, cf. figure 1.2. These changes give the first counter-argument to simple outsourcing explanations of the growth of service sectors - that service growth is caused by a spinning off of service functions of lesser strategic

importance. While manufacturing employment has diminished, employment of high skilled white collar employees has increased; there is a strong ‘upskilling’ in manufacturing industries. The share of employment growth accounted for by these occupations in market services is similarly considerable. The implication is a gap between the composition of the exodus from manufacturing and the influx of employment into market services. aggravating the structural unemployment in the OECD countries. Concomitant with the growth of advanced business services, the share of ‘information’ or ‘knowledge’ workers in the economy has risen.

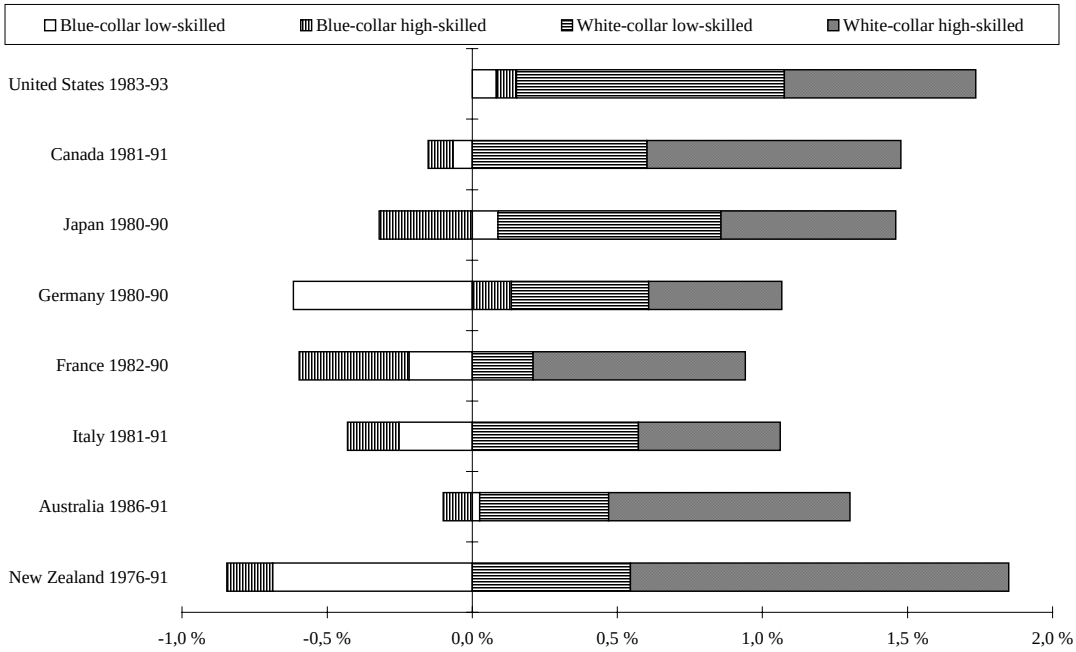

Figure 1.2 Employment growth by occupation categories in manufacturing and market services. Average annual growth. Source OECD 1996a
The white-collar high-skilled group in Germany excludes some occupations and is thus underestimated.

iii) The third indicator is related to technology use. As we will see, the expanding service sectors are capital intensive, i.e. heavy users of capital equipment. The share of capital goods going into service sectors, cf. figure 1.3, confirm that these sectors are intensive technology users. This implies that the service sectors also include a significant share of sophisticated users of technology, primarily information and communication technologies, and that these sectors therefore influence the development of these technologies[1].

[1] This is not the only way these service sectors affect technical change and innovation in other sectors, but it is the one that is most directly identifiable.

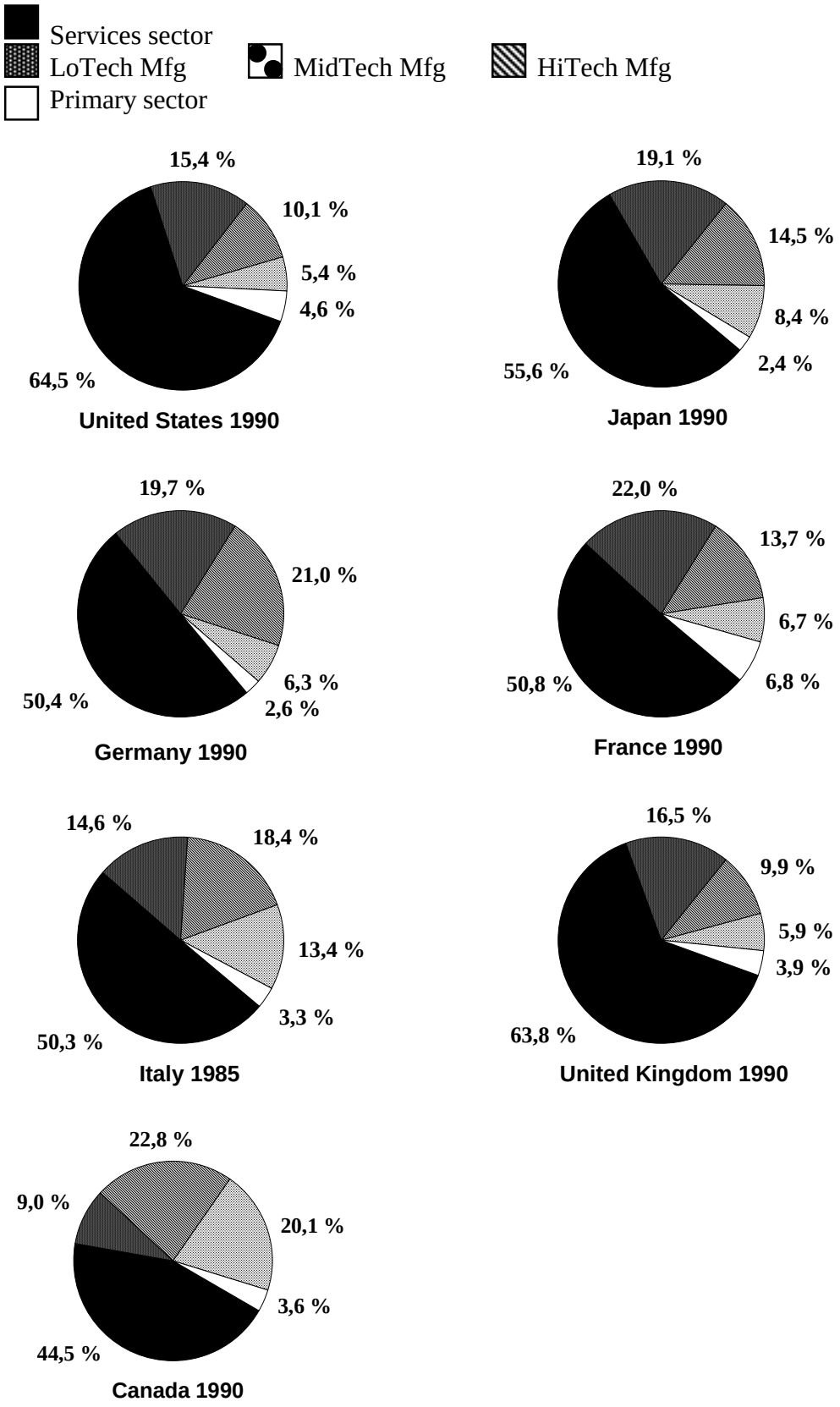

Figure 1.3 **Acquired technology by user sector in G7-countries. Source OECD 1996a**

iv) Whereas 'traditional', goods-related services like trade and transport have been affected by business cycles just as much as their companion manufacturing sectors, business and financial services seemed to be insulated from the effects of cyclical downswings, at least up to and including the 1980s, cf. the discussion in Fuchs 1968. This lead to a view that there were 'peculiar' aspects of services that made them less affected by business cycles. For a modern reiteration, see Lee 1996. A further illustration of the coming of age of these service sectors is that in the 1991-92 recession, these service sectors were hit with receding or even negative employment growth rates (see OECD 1996a).

1.2 The service society

Economic growth over the last decades has therefore been strongly affected by development of service sectors. This has opened up for characterising contemporary society as a 'service society', or to emphasise the role of information and knowledge, as an information society. The use of such terminology has connotations to a service or information revolution; a new industrial revolution, marking the watershed between the industrial society[2] that emerged over the last 150 years, and the new service society.

But since the activities called 'services' form an extremely heterogeneous bag, it is not immediate that the emerging economic structures deserve a label like 'service society' or 'service economy'. Service sectors are not, at least yet, characterised by any visibly coherent pattern of 'industrialisation'. The same applies to the designation of information or knowledge societies. These are designations that are so evident that we immediately accept them, but so vague that it is unclear what their content really is, apart from describing some obvious surface phenomena. Therefore, we will end this section by asking if the label service society is appropriate as a characterisation of ongoing structural change.[3] To do that we will start with the concept of an 'industrial society' as a benchmark.

When the manufacturing industries matured during the nineteenth century, through the complementary processes of market growth, technical change and organisational development, the industrialisation lead to an overall productivity and income growth, dominated by these industries. They were the economies' productivity leaders and they also had a strong influence on productivity in other sectors, primarily in the second large sector, agriculture. As the manufacturing industries grew in size, they increasingly affected and shaped the society in which they were embedded. The development of new organisational forms and formalised relations between workers

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[2] The adjective industrial in the term industrial society/revolution refers to the original meaning of manufacturing industries, whereas in all other contexts in this report we will use the terms industry and industrial in the more modern wider anglo-saxon sense of production activities. Hence we will characterise trends of standardisation and formalisation of production processes to achieve scale economies 'industrialisation', whether it refers to manufacturing or service production.

[3] We could equally well have asked the same question for the terms of information and knowledge societies.

and capitalists and managers affected the social roles of the different classes, the growth of the industries ensured a rapid diffusion of these roles in industrialised areas. As the nineteenth century drew to a close, quite a few countries had emerged as industrial societies, several others followed quickly after. Even though manufacturing industries never attained a share of employment compared to the one of agriculture previously, and the share ascribed to service sectors today's, the social development in this period is so intimately linked to these industries that the epithet 'industrial society' is pertinent.

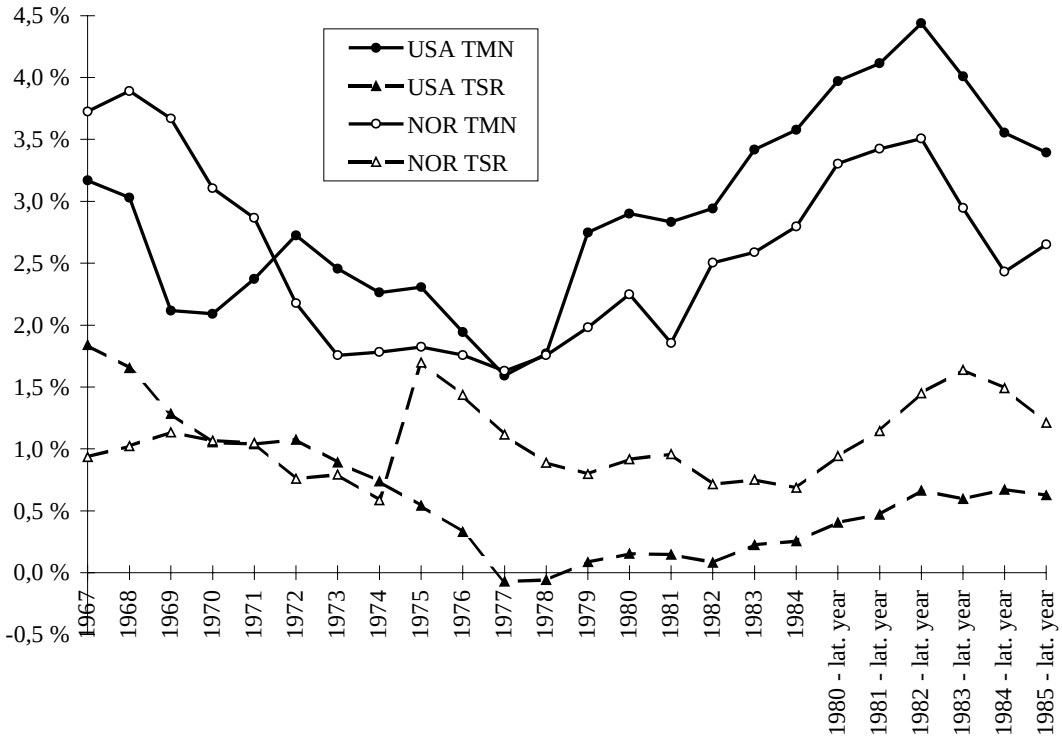

Figure 1.4 Labour productivity growth[1] in manufacturing and service sectors. USA and Norway[2] 1967-1990[3,4]. Source: OECD ISDB 1993

[1] Labour productivities are calculated as the ratio of GDP in 1985 prices, expressed in US$ equivalences, to total employment. The growth rate of sectoral labour productivities are calculated as a centred 11-year moving average to identify the long term trends.

[2] The abrupt increase in the service sector growth rate from 1974 to 1975 is an effect of 20-25% decrease in the gross product in the trade sectors from 1969 to 1970. This is probably a technical effect of the introduction in Norway of the 1968 UN Systems of National Accounts.

[3] The latest available year for USA is 1989.

[4] For the periods with centres 1985 and later the last available year is used as termination point. Hence the last period includes 5 and 6 years for USA and Norway respectively. Thus the curves are increasingly disturbed by short term fluctuations towards the right hand end.

So the first question to ask is if the service sectors have a similar position in terms of productivity growth as manufacturing industries 100 years ago. Figure 1.4 juxtaposes the growth of labour productivities in manufacturing and service industries since the middle of the 1960s in two OECD 'extremes', USA and Norway. Total manufacturing (TMN) include manufacturing and utilities, while total market services (TSR) include retail and wholesale trade, hotels and restaurants, transport and communication, FIRB

and social services, excluding governmental services. In spite of the extremity of the juxtaposition, the similarities are striking. There seems to be a consistent gap of about 1-2% in the long term productivity growth rate between the large sectors. If productivity in manufacturing grows with about 3% annually, labour productivity will be doubled in 20-25 years, whereas the service productivity would need nearly 70 years to double[4]. Considering that the employment behind the services figures may be up to three times larger than the manufacturing employment, this has implications for the development of these economies.

If the decline in manufacturing employment is slower than productivity growth, the share of real output from manufacturing sectors may still increase, even with growing productivity in service sectors. An increasing share of production will emanate from a sector that decreases in terms of employment. The productivity gap will affect relative prices, making e.g capital equipment cheaper. This would allow enhanced productivity growth in services by expansion of the capital base. On the other hand intersectoral trade will make productivity growth in manufacturing increasingly dependent on the productivity of the service inputs, as these will ultimately correspond to the bulk of the costs of manufacturing production processes. Thus we are led to predict a convergence of productivity growth rates of the two sectors.[5]

The gap between the sectors in figure 1.4 suggest that this intersectoral equilibrium is not yet attained. It is well known that service output statistics may be misrepresenting actual levels of service output (Griliches 1992 and Sherwood 1994). But even if there is a gross mismeasurement of service output levels, this does not immediately imply that growth rates are mismeasured in public productivity statistics.[6] Even allowing a mismeasurement of growth rates, the gap between the rates in the two sectors is still so substantial that it seems improbable that revised productivity measures can close the gap.

The second feature we note is the similarity between each of the sectors between countries. In spite of the size differentials, levels and cyclical patterns of productivity growth rates, are remarkably similar. Thirdly the figure also signals a significant correlation between the long term cyclical behaviour of the two sectors over time.

All this suggests that using the concept of a *service* society to characterise long term determinants of structural processes, is misplaced. The simple indicators and arguments suggest that there are strong intersectoral linkages that contribute to shape

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4 Of course this is too simple an argument to be realistic, as it disregards important differences between ‘progressive’ services with high productivity growth and services with low or no productivity growth.

5 This argument is a generalisation of the Baumol cost disease to include intersectoral trade, cf. Baumol 1967, Baumol & al 1989.

6 That is, the indicators that are used for output measurements may still be good proxies for the growth rate of outputs, even if the level of output volume is wrong. Evidently this is an argument that may apply to service sectors where output is not directly measured as inputs, such as labour inputs.

the development of advanced economies. But the present economic structure may deserve the 'service' label for other reasons, though.

Since service sectors account for more than half the total employment in most OECD countries, they may be termed service societies in a weak sense. The term is then describing what contemporary society is not; due to the heterogeneities of the service sector, we cannot give a positive definition of the whole sector. Furthermore, the characterisation is weak because the share of service employment may be a simple reflection of underlying gaps in productivity growth. The discussion above point out that if we use productivity developments as the characterising feature, a better term would be service-industrial society. One may even argue that as long as the productivity gap seems to be positive and real manufacturing GDP is substantial and growing, the concept of an industrial society is still valid (cf. Cohen and Zysman 1987).

There is however one related reason for describing present day economies as service economies. If we consider inter-industrial relations, there have been significant changes in these relations over the last decades; the interactions between service sectors and other economic sectors have increased. But not in the sense of non-changing services getting more involved in manufacturing industries; the central characteristic is the continual change of existing and appearance of new services, in conjunction with intensified relations between these and other sectors. Financial and communication services are prominent in these changes, but they have also affected other types of business services.

Nevertheless, what the statistics show is growing service *sectors,* and not necessarily growing service *functions*. The total service production may still be roughly constant, with the growth of services being a statistical artefact, caused by an increased 'outsourcing' of service functions. Such an argument imply that we are far from any transition from an industrial to a service society. Even though such unbundling of service activities; that companies find it more efficient to outsource service functions, may be important, three qualitative phenomena show that this can only be a part of the story.

First, as noted above, the enhanced inter-sectoral relations show links to the development of new information and communication technologies, which in itself gives the processes new aspects. Secondly, changes in employment in the 'grand sectors', cf. figure 1.2, imply at least that it is not the high-skilled white collar labour force that is shed. This could still be accommodated in an out-sourcing argument, since the changes shown in figure 1.2 are *net* aggregate changes. The FIRB-services included in figure 1.4 increased their employment in the 14 OECD (OECD14) countries covered by the OECD InterSectoral DataBase[7] with about 9 million employees in the 1980s. If a substantial share of this is explainable in terms of

[7] The 14 countries are the G-7 countries; USA, Canada, Japan, Germany, France, Italy and United Kingdom, and seven high-income smaller countries, Australia, Belgium, the Netherlands, Denmark, Norway, Sweden and Finland.

unbundling of these services from manufacturing, we should see a significant increase in the level of labour productivity growth in manufacturing industries.

To show this, we note that it cannot plausibly be argued that the service labour force is substantially more productive inside manufacturing firms than in specialised service firms. Hence the process should in this case show up as roughly 7% increase in manufacturing labour productivity over the decade, assuming that this accounts for half the increase in FIRB employment, or a 10% reduction of overall manufacturing employment. There seems to be no signs of such an extraordinary increase.

Furthermore, there is a substantial imbalance between the growth of the TSR-services in figure 1.4, excluding social services, and the decline in manufacturing employment. Services employed over 14 millions more people in 1989 than in 1980 in the OECD14 area, while manufacturing employment fell by less than 5 millions. All in all this points out that even though the 'out-sourcing' argument may give important bits to the puzzle, it reveals only a part of the whole picture. Our conclusion is that the patterns of inter-industrial trade may support the use of terms like service societies to characterise these developments.

Table 1.1 Service share* of private and government consumption 1990 in selected countries. Source: OECD 1995c

	Private consumption	*Government consumption*	*Private and government consumption*
Japan	47,2 %	75,5 %	50,9 %
US	50,5 %	57,5 %	52,0 %
Germany	37,7 %	70,5 %	46,1 %
UK	31,4 %	88,6 %	50,1 %
*Netherlands***	46,1 %	87,7 %	56,8 %

* The service share is based on hotels and restaurants, transport, storage and communication, real estate and business services, community, social and personal services and government services.

** 1986

Another class of argument to defend the use of the appellation service society is to adopt it as a characterisation of wider social frameworks. The service share of domestic household and public final consumption is larger than 50% in several countries, even when excluding trade sectors, cf. table 1.1. Even in household consumption alone, the service share is quite substantial. Hence the term could be used to suggest the dominance of services in domestic consumption. The share of services could however be said to be nearly tautological, as it includes the intra-governmental transactions of government services, the volume of social and health services to consumers and real estate services to households. We would therefore not expect the service share of consumption to show a clear break over the long term, but to remain high even in the classic industrial society.

A related argument points to the fact that demand for services is highly income elastic; i.e. that the consumption of services will increase faster than other types of consumption as income increases. This is confirmed by cross-sectional data, but as pointed out by Gershuny 1978, over time there is a countering trend, reducing the service share at any relative income level. Over time, service consumption is substituted by household durables, leading not to a service economy, but to a self-service economy.

We noted initially the heterogeneity of the activities and functions we usually term 'services'. By asking whether these service activities create 'leading' structural characteristics of present day societies, we have implicitly asked if there are some common traits of the kind of activities that we call services that impart on the development of advanced economies in a coherent way. Given the negative, or residual, character of the identification of service or tertiary sectors[8], it is not surprising that it is difficult to identify such common characteristics - such as levels of employment - as indicators of structural changes. But there may still be positive aspects characterising significant subsets of the residual bag of services that may be used to denote the transformation of advanced economies. We will return to the question of such 'peculiarities' of services in chapter 3.

Even though we have rejected levels of employment as an argument in favour of the label, these levels point to some associated arguments. It is still unclear how the growth of service functions and occupations will affect work organisation and social structures, but many approaches stress the emergence of 'post-Fordist' structures as a central characteristic of service or information economies, structures that will replace the 'Fordist' work organisation and relations that complement manufacturing production. For a review and discussion of such arguments, see the recent publication EC 1996. This is a fruitful avenue, but again we see that the characterisation is essentially negative[9], here due to few clear indications of what unites the post-Fordist structures.

The last argument may be extended to include the social and cultural environment of the population. As the activities called services engage the majority of the population in these countries, this majority will have its social framework shaped by participation in service-providing functions. To the extent that there are commonalties across different service functions in the shaping of social networks, work organisation etc., these commonalties will shape society as its members conceive it. Then contemporary society can be said to deserve the label service society. We conclude that the restructuring of the advanced OECD economies deserves the service economy label; drawing attention not to the service sectors themselves, but to the emergence of complex interrelations between new and altered services and other productive sectors in the economies, and to changed social environments. Then the term has connotations similar to the usual interpretations of the concepts of information or knowledge societies; the services that are the 'vanguards' of this development are primarily

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8 The tertiary sector is the residual after the primary and secondary sectors have been identified.

9 'Post-Fordist' work organisation is the part of 'non-Fordist' work organisation patterns that emerge later in time than 'Fordist' patterns.

knowledge-intensive services; service producers and providers that are intensive knowledge users, distributors or producers.

1.3 Challenges and trends

Above we suggested two trends to characterise the structural change of advanced economies. We identified them as changes in the welfare state and as a 'complexification' of economic activity. Both pose challenges to our understanding of these 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.

Whereas the first trend is a wider process, the second one is dominated by economic interactions and economically motivated processes. This allows an economic approach to this trend, whereas analysis of changes to wider social welfare requires a multi-disciplinary approach. In this report our focus is restricted to the economic trend, and primarily to the last two points as they apply to services. In our future work we will consider the further extension to include other sectors, and to aggregate social changes.

The modern period of studies of the emerging economy started in the mid-1960s. In *The New Industrial State* (Galbraith 1967), Galbraith described what he regarded as the main structural reorganisation of economic production in the new era. He saw a new industrial organisation emerging, replacing the capital-based and owner-managed industrial organisation that was completed in the first post-war period. What John Galbraith saw as the fundamental new feature of industrial production and value-creation was the emergence of a new governance structure in large scale industries, *viz.*, a knowledge-intensive management structure with a different set of interests than the previous 'owner-manager'. Combined with increased abundance of capital, and hence a weakened power base for it in initiating and organising commercial activity, this paved the way for the *technostructure* as the critical factor that would shape progressive industries.

Thus Galbraith clearly saw the vital role that knowledge and expertise would play in organising future economic activity, but he chose to interpret it as a reorganisation of *manufacturing* industries, with large scale, technology-intensive industries as 'vanguards' of the new industrial restructuring. But what he did not take into account was that the underlying processes he used as a basis for his predicaments about manufacturing industries, also opened up for a restructuring of vital services and the relation between these service functions and manufacturing activities. Hence we will regard John Galbraith primarily as a beaming culmination of previous analytical approaches to structural change in capitalist economies, rather than as an approach that establishes a genuinely new 'mind-set'. This is not to deny, however, that Galbraith's analysis definitely points forward and renews old approaches, but his manufacturing 'bias' lets him by-pass at least one of the characteristic dimensions of the restructuring of economic systems during the last decades.

Almost simultaneously with the publication of Galbraith's book, Victor Fuchs published the first modern approach to the emergence of the 'service economy' (Fuchs 1968). In contrast to Galbraith, Fuchs took as a starting point that the characterising feature of the development of the capitalist system in the modern era is the emergence of a complex of services. The analysis was substantiated by cosiderable use of statistical data to identify characteristics and drivers of change processes. Fuchs followed the lead of Colin Clark (Clark 1957); 'tertiarisation' is the next stage of economic development in industrialised countries. Fuchs hypothesised and elaborated three broad explanations of structural change in modern economies and the concomitant employment growth in services. The three explanations, that have been elaborated and used widely in the literature following Fuchs, were

- an 'Engelian' argument about the consumer income elasticity of consumer goods and services.[10] As real incomes increase, the share of services in total consumption will rise with rising income, other things being equal, due to the high income elasticity of services. Increased demand for services will force an increase in service employment,

- 'techno-structural' arguments of intermediate service demand, i.e. changed division of labour in production processes; because of increased use of specialised services in production, or as a consequence of reduced transaction costs towards producer services, and

- 'cost disease' arguments; the lower productivity growth rate of services creates the need for 'running to remain on the same spot', i.e., an escalating real price of services relative to manufacturing products. This will either lead to all income being spent on services, to a degradation of service quality to restrain galloping prices, or to accelerated social innovation.

Fuchs argued on the basis of statistical data that slower growth of labour productivity in service industries was the major explanator of the shift into service employment in the US between 1929 and 1965. On the basis of Fuchs' data, the productivity gap is estimated to account for 55% of the growth of the service share, while the income hypothesis explains just 14% of the growth. The residual of about 30% includes the techno-structural arguments, as well as exogenous demand shifts of services. Data for the period 1966-1981 suggest that income effects explain only 7% of the service share growth, while the cost disease argument accounts for about 25%. As a consequence, the residual has more than doubled in comparison to the previous period, suggesting

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[10] It is called Engelian to refer to the study of consumption of food by Belgian population in the 1860s by the Preussian statistician Ernst Engel. He showed that the incom elasticity of food demand was less than one, i.e. that as income grows the food consumption grows less than proportionally. The share of food consumption will decrease as income grows. In that sense we maight say that Engel predicted the relative decline of the agricultural sector. Engel's law is usually stated to mean that as average real income grows, the consumption share of goods with a high income elasticity will increase, at the cost of a reduced share of low income elasticity goods. The Engelian service argument is that service demand has an income elasticitiy greater than one.

that new mechanisms are active in more recent periods. These data are discussed in Inman 1985b.

The size of the residual suggests a need to go beyond these three arguments. The first set of such extensions would be to include substitutability and complementarities between consumption of tangible and intangible goods. These include complementarities between tangible goods and services through a clustering of consumption; consumption of tangible goods - such as household durables and other capital goods - enhance the demand for related services, as well as vice versa (see Stanback 1979). Secondly they have been supplemented by the 'post-Engelian' argument of Gershuny 1978; an increased *substitutability* between material goods and services as to the provision of utility, shifts demand from services to material goods. This is reinforced by changes in social behaviour that alter consumption patterns in significant ways, through 'social innovations' (Gershuny and Miles 1983).

The overall 'service content' of the economy grows, with a shift towards higher skilled white collar employment in most industries, away from low- or un-skilled blue collar employment. This is accompanied by an increase in flexible, service-like production methods in several manufacturing industries, the evolution of 'post-Fordist' production. As the structure of labour markets and work relations have a strong Fordist heritage, there are strong contingencies between the dominant modes of production organisation on the one hand and work organisation and governance structures on the other. Increased flexibility of work arrangements and dissolving barriers between work and leisure, between education/training and knowledge and skill use suggest new forms of work relations in several functions. These processes could lead to increased externalisation of service functions, and hence contribute to increased service employment.

It may be difficult to distinguish the effects of these processes from effects of the three arguments given above, particularly the 'techno-structural' argument. The post-Fordist argument may even be claimed to be a subset of the techno-structural arguments. Both types of arguments find among their causes a changed role of inputs to production processes; particularly of information inputs. But whereas the post-Fordist argument describes an adaptive process to wider socio-economic changes, the techno-structural argument concerns both reactive and proactive changes. On the other hand it is restricted to production or market characteristics, whereas the post-Fordist argument is wider in scope.

It is immediately evident that all these arguments contain elements of truth and contribute to the evolving process; the development of modern capitalist societies. It is equally evident that these arguments are mutually interdependent. Nevertheless, based on historical data, the role of the cost disease argument in explaining the share of employment in service sectors seems to be significant, but the balance may have shifted towards more 'techno-structural' arguments over time. This underscores the need to understand the unfolding dynamics and their consequences on at least two levels; at *policy level* the development is important both in terms of general welfare policy and as a prerequisite for relevant industrial policies, at the *business and industry level* they determine the possibilities for business strategies.

This leads to the two great paradoxes of this area of research; dynamics involving service sectors have been under-focused both in the *research attention* it has received, though with some notable exceptions, and in *policy formulation*. The implicit assumption seems to be that manufacturing is still what matters. There are, however, signs of a change in awareness of the issues involved, as the following citation from the Delors White Paper suggests:

> "The key elements in competitiveness that are now of greatest importance ... include in particular the quality of education and training , the efficiency of industrial organisation, the capacity to make continuous improvement in production processes, the intensity of R&D and its exploitation, the fluidity of the conditions under which markets operate, the availability of competitive service infrastructures, product quality and the way in which corporate strategies take example of the consequences of changes in society, such as improved environmental protection." (EC 1993)

To what extent these changed attitudes affect policy content is more uncertain. The attention given to service related issues in recent OECD work, such as the study *Technology, Productivity and Job Creation* (OECD 1996a) and the forthcoming edition of the *Science and Technology Policy Outlook*[11] is noteworthy. The role OECD projects have played in the past as indicators of policy change in member countries suggests an emerging reorientation of national policies. Similarly, a large study of the Danish economy was undertaken recently as a background for Danish industrial policies. This study included a substantial focus on service sectors, on a par with other industrial sectors, see f.i. Erhvervsfremmestyrelsen 1994.

The patterns or features showing up in aggregate statistics or overall behaviour are contingent on or shaped by microlevel activities and processes. Changes in labour productivity are aggregations of various change processes at the micro-level, processes that involve technological innovation, organisational change, learning and development of new business areas. But these are not autonomous local processes; there are strong complementarities and systemic features across firms and industries. These processes participate in national innovation systems.

This suggests a need to combine studies of microlevel data with a framework of meso- and macro-level and analytical projects that incorporate such systemic features. The focus on change processes suggests that a central element must be innovation processes; innovation processes are a central, if not *the* central element in the reshuffling of cards that generates aggregate change patterns.

1.4 Report outline

This report is divided into four sections. The fourth section is an extensive bibliography of the issues raised in the report and constitutes the 'state of the art' of our present understanding of these issues.

The present section, Services and the economy, consists of three chapters outlining the role services play in changes to economic systems. While the present chapter has outlined aggregate characteristics of the development of service societies, and possible

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[11] This study is in progress under the auspices of the Directorate for Science, Technology and Industry, see the draft report OECD 1996b.

explanations of them, the following chapter discusses questions related to the development of service sectors. In particular we will outline how we approach innovation in services conceptually, to place a more restricted approach of technology in services in context. On the basis of the first two chapters, chapter 2 concludes by summarising important challenges facing our understanding of services. Chapter three describes and discusses the economic roles and properties of services, emphasising the so-called 'peculiarities' of services.

The second part of this report constitutes the main part, outlining frameworks for understanding innovation processes in service activities. We start this section with a more thorough discussion of the role of R&D and capital goods in service sectors, being followed by a more developed approach to typologies of innovation in services. Chapter 5 describes empirical investigations into the volume and character of innovation in services, both through wider surveys and more restricted case studies. Chapter 6 discusses some analytical attempts to develop innovation theories for services. Chapter 7 give a summary of the main conclusions of this section.

In section three we give some tentative outlines of a framwork for analysing how services partake in economic interaction and development. Two appendices describes the SI4S project.

2 Why are services of interest?

2.1 Introduction

When continually stressing the heterogeneities of the services and the interrelations between dynamic business services and manufacturing industries, it is worth asking if services as a separate category really are worth a specific focus of economic research? Would it not be better to regard them as aspects of wider economic dynamics in economic sectors?[12]

We cannot answer this question definitely at this stage, either yes or no. Our present understanding of industrial dynamics does not allow us to draw the warranted conclusions. Supposing we had a more complete theory of industrial dynamics, the suggested answer would be no, ... and yes. But in answering the question, we have already answered two underlying questions. First as regards the prime interest of studies of service sector dynamics; if our interest primarily concerns characteristics of economic development, with changes in market and product structures, and associated change in service industries, it would seem that understanding overall structural change and service innovation must be related to wider issues of industrial dynamics. But if our interest primarily relates to the social and welfare impacts of structural changes, to the socio-cultural content of service activities, it opens up for a service focus, even though the approaches ultimately must be interrelated.

The second underlying question involves asking about the existence of such a grand theory, or theories, of industrial dynamics. Even though there have been many attempts to develop such 'systems' theories, such as the French *Régulation* school (Boyer and Saillard 1995), Michael Porter's clusters (Porter 1990), national innovation systems (Lundvall 1992, Nelson 1992) and technological systems (Carlsson 1995), each with many merits, there is no well-established understanding of the dynamics underlying economic development. In the absence of such understanding, we have no way of determining whether different types of services participating in the processes have an autonomous role or play a more passive, responding role. To put it more directly, we cannot say if dynamic service industries offer prospects of autonomous growth.[13]

Our interest is primarily related to socio-technical aspects of structural change, which would seem to permit a neo-industrialist 'techno-structuralist' approach. In our view this is a premature decision. There is no doubt that the development of the multi-faceted service sectors in all advanced economies forms a part of the substantial restructuring processes that are evolving. Equally it is clear that these processes are not caused by the *apparent* characteristics of the growth of the service economy; characteristics that are the effects, and not the causes of the processes.

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12 This would correspond to a 'neo-industrial' approach á la Galbraith, a strong version of which forms the basis for the arguments of Cohen and Zysman 1987.

13 This opens up the big question of our still meagre, overall understanding of economic growth processes.

A first step towards a better understanding of these processes, is to ask how a variety of factors affect service sectors and functions in the society, as well as in the economy at large. This regards both understanding the dynamics evolving before our eyes that change and restructure services, as well as the wider economic landscape.

Even in a shorter run, there is a definite need for better understanding of economic dynamics and the functioning of the service society. When 60-70% of total employment is in service sectors, and with most of it in private sector services, this implies that the majority of the population in advanced economies find their social role and welfare shaped by these sectors, both culturally and economically. The size of these sectors is nevertheless generally not reflected in industrial and economic policies; they may be characterised, politically speaking, as passively tailing the main focus of these policies; manufacturing industries.

Our argument is that it is not possible to accommodate the spectrum of change processes in service sectors in this perspective. Innovation in services is showing straits and dynamics that go beyond the indirect adjustment to processes happening elsewhere in the economy; the view of service sectors as passive employment and technology sponges is not correct. This raises serious doubts about the present profile of industrial policies, and creates the need for a more solid foundation for reconsidering these policies. Contributing to this is the ultimate aim of this work.

Our focus will deliberately exclude public services, we will focus on service provision outside the public sector. The distinction between private and public sector activities is of course not unambiguous; both because there is no constitutive element that defines most services as either public or private and because the institutional framework for service provision varies considerably between different countries. But our mental frame will primarily be focused on services provided by private sector organisations with economic motives (though not necessarily for-profit). The reason for this distinction is not that public services is void of interest; on the contrary. The problems in analysing change and innovation in public services is probably substantially larger and more complicated than in private sectors. The reason for the restriction is first of all one of comparative advantages; our competencies on public sector issues are relatively weaker than the ones forming the backbone of the present work.

Secondly, in terms of the inner workings of the economic system, the interrelations between private sector services and other economic sectors suggest that the first priority should be to understand these relations and the associated processes, and what position these relations should have in industrial policies. More specifically, interrelations between different economic sectors and characteristics of services' innovation processes have two important implications. Firstly, services form a vital, and considerably under-focused, part of innovation systems. Secondly, innovation policies that refrain from paying attention to these sectors will be severely limited in their possibilities of attaining objectives of socially beneficial innovation activities.

2.2 On innovation in services

Focusing on micro-level characteristics of services, we must first cope with the heterogeneity of services. In the first section of this report we will take the heterogeneity for granted, using the terms 'services are ...' as synonymous with 'there are significant service sectors which are ...'. One of the questions raised in this report is to what extent a focus on *technological innovation* misses significant dimensions of the innovation processes of services. It is not our aim to answer this question definitely, but through discussion of some of the relevant literature, we will see strong indications to support this view.

Joseph Schumpeter (see in particular Schumpeter 1987, but also Schumpeter 1934) pointed out that the simplified picture of profit-maximising price-competing firms, with price as the main information carrier between the actors on the market, was too simple a picture to explain the development of market systems. In addition to price competition there is an even more important technological competition; with firms competing on qualitative characteristics of products and processes, what counts is "the competition from the new commodity, the new technology, the new source of supply, the new type of organisation - competition ... which strikes not at the margins of the profits and the outputs of the existing firms *but at their foundations and their very lives*" (Schumpeter 1987, our emphasis). This lead directly to a 'fuzziness' of the technology that is offered to the market; with the market playing the role of a technological selection mechanisms. The existence of technological competition emphasises the central role of the innovator, or *entrepreneur*, in Schumpeterian economic dynamics. One of the important implications of this for the Schumpeterian dynamic processes of the capitalist system, is the phenomenon of the 'gales of creative destruction'; waves of innovation passing through the economic system and reshuffling the capitalist 'deck'.

Schumpeter identified five classes of innovation that were important determinants of economic outcomes. The first two; technological product and process innovation, have almost exclusively been focused on in the innovation literature. As Schumpeter's focus was primarily on *industry* level and not on *firm* level, an innovation was something that was new to the world - it was new to the industry. Hence he regarded also his third category - organisational innovations - as the appearance of new general organisational modes transferable to and applicable in a wide variety of firms, as well as restructuring on the industry level. The industry perspective excludes adjustment and imitation processes of the original industry-level innovation, as well as other local, 'new to the firm' innovations. Local reorganisations of business firms that are highly specific to the individual firm are thus excluded from his perspective. His two last categories of innovation were the conquering of a new source of input or raw material, which we would probably not consider an innovation today, and the opening of new markets.

If this five-tier system is to be complete, we note that the qualifier 'technological' of product and process innovations must be interpreted in a wide sense. Secondly we note that the classification provides a suitable analytical distinction, but that classifying individual innovations will often be more ambiguous. There will often be complementarities between these analytical aspects of innovations; introduction of an existing product to a new market may involve changing properties of the product.

New processes may often require considerable organisational change. A product innovation will frequently require new or changed processes in its production.

Current focus on innovation processes differs somewhat from the perspective of Schumpeter. First of all the OECD Oslo manual on innovation surveys (OECD 1992a), as well as the many innovation studies based on it, focus on firm-level innovation. A firm-level approach makes innovation and diffusion complementary, rather than dichotomous, concepts. The intra-industrial diffusion process is considered an integrated part of innovation processes.[14] Thus they explicitly include imitation as significant aspects of the overall innovation processes. Including adoptions of innovations by imitators, encompassing adaptations of the innovation, organisational adjustment and learning, implies integrating Schumpeterian innovation and diffusion of innovations.

The level of innovative activity differs quite considerably according to whether the analysis is restricted to 'new to the industry' innovations or includes 'new to the firm' innovations, and the ratio between them can distinct industry-specific patterns. There are no immediate reasons to believe that this picture differs qualitatively between manufacturing and services industries. It is often claimed however that the innovator's appropriation of benefits from the innovation is more difficult in services as service innovations are easy to copy. Whether this is correct or not is an open question, but if it is correct it suggests that firms would be more likely to reduce resources put into innovative activities or to make more intense use of mechanisms like secrecy to keep innovations out of the public domain. Either way it would tend to diminish the gap between industry- and firm-level innovations, perhaps reducing the *apparent* level of innovative activity.

This raises the question of what we mean by the concept of innovation. Innovation is a concept where there is considerable variance in individual observers' definitions; both between common sense - or lay - understanding and analytical approaches, and between different analytical approaches. One element common to all these approaches is that market introduction is a crucial aspect of innovation. This is what distinguishes innovation from invention, the concepts are incomparable in the sense that invention is a technical concept, innovation an economic concept. But they are not wholly unrelated; technical feasibility is a necessary, but not sufficient condition for economic feasibility.

The term innovation has a built-in dualism; innovation refers both to the act or process of innovating and to the outcome of these innovation processes. The innovation process is a process of codification of a codified innovation that is launched onto a market. Furthermore, this involves market introduction of something *new*, whether in the form of a changed or new product or through products produced with new or changed production processes, organisations, capital or intermediate inputs.

The features that emerge as essential in this, are evidently the *novelty* of the innovation and that it is intimately linked to market systems. Hence the concept of

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[14] Similarly the perspective may be expanded further to include intra-firm diffusion.

innovation must be understood as organised activities that produce outcomes that change market characteristics. Our concept of innovation starts from this; *innovations are organised activities* by the firm, i.e., deliberate, institutionally based activities, that have the effect of *changing characteristics of the markets* on which the firm operates, including the performance of the firm itself.

We have not distinguished between a firm's different roles, as to whether it innovates in the role of supplier or customer, that is whether the market involved is up- or down-stream. While in the first, innovation-as-supply-side-phenomenon product innovations may more or less dominate over process innovations, the second is more exclusively dominated by process innovations, as the introduction and adaption of new capital goods[15]. Even though concepts of product and process innovations may be difficult to disentangle, this discussion points out that the effect may be on both up- and down-stream markets. Furthermore it points to a dualism between some process innovations and product innovations on intermediate markets. The importance of learning-by-interacting and user-producer relations (Lundvall 1985 and 1992b) strengthens this dualism, even to the extent of making it difficult to distinguish the two processes.

Nevertheless, the ultimate effect of innovations as economic phenomena are related to the commercial effects on the markets that the innovator is supplying. This makes it correct to state that innovation is a supply-side phenomenon, but this is different from characterising driving mechanisms of innovation processes, whether they are pushed by suppliers or pulled by customers. Market introduction presupposes the existence of a market. The process of introducing innovations into the economy may however in several instances be considered as the creation or opening of new markets. For services it is claimed that it is necessary to include a new class of innovations into this spectrum - delivery innovations (Miles & al 1995). Delivery innovations are described as innovations in the delivery system or medium of the service provider, such as IT-based service provision. It is interesting to note the similarities that this suggests to the opening up of new, though substitutable, markets.

Since the concept of innovation involves at least novelty to the firm, the change in market characteristics is related to a change in some firm characteristics. This excludes activities like price dumping that may change market features, but are unrelated to concomitant changes in organisational features of the firm. We also use this restriction to exclude market strategies like brand naming. But we note that this 'borderline' area is largely uncharted from the perspective of innovation studies. The grey zones are potentially huge and there are few guidelines as to where to put the 'lower' cut off of innovations,[16] which emphasises the fact that innovations are part of a vast continuum of commercially motivated activities.

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[15] These concept make sense as long as we wither consider homogenous industries, or representative or individual firms. As soon as we allow heterogeneities the distinction between product and process innovations may loose clarity. Similarly in relating different industries, if industry A is supplying industry B, the introduction of industry A's product innovation into industry B's production is a process innovation from the perspective of industry B.

[16] The Oslo manual formulates a cut off that is by now quite standard (OECD 1992a). The cut centers on novelty and significance of the change in product and process characteristics to

These considerations raise several challenges for innovations in service firms, especially in providing client-intensive, customised services. The Oslo manual is primarily designed as a guide to surveys of innovative activity in manufacturing sectors of the economy. As an example of the kind of limitations that this raises for service analysis is the suggested criterion that technological innovation in the Oslo manual sense requires "testing of a prototype or other R&D activities in order to change one or more of the product's attributes" (OECD 1992a). Innovations in service functions in (manufacturing) firms are excluded; innovation in "ancillary and supporting activities [such as] computerisation of the sales or finance department should not be considered an innovation".[17]

At the time of Schumpeter's formative thinking a 'manufacturing' interpretation was natural and inevitable. The 'manufacturing' bias has led to an interpretation of innovation primarily in terms of its role vis a vis Schumpeter's aspect of technological competition, and a concomitant view of organisational innovation as subordinate to technological innovation processes. The ultimate expression is a view that organisational change may be decisive for the ability to adopt technological innovations and reap the benefits from it, but that it is a firm-specific adaptive mechanism with no autonomous role towards the development of qualitative technological and economic characteristics of the innovations.[18,19]

It is an open question whether this position is generalisable to all services. The interplay between organisational and technological innovation may even possibly be reversed in some services. Considering services where knowledge generation is a constitutive element of the service, like R&D services, consultancies and segments of software development, we suggest that organisational structure has an autonomous role, at least on par with the technological platform for the service production. This is suggested by the direct role learning plays in these production processes. This is in contrast to production that is better characterised as knowledge using, where learning has a more indirect role of allowing increased efficiency or changed production structures. Learning, as the enabler of knowledge generation, is an integrated part of the production process that generates such knowledge products. These learning activities may vary and may have a wide range of characteristics. One feature that might prove to be essential is that they involve learning through accommodation to

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distinguish innovations. Minor technical and aesthetic modifications are excluded, as are product differentiations. But this is a diffcult area, which it evidently also was to the authors of the manual. The formulations raises at least as many questions as they answer, but ultimately leaves the distinction to the respondent of innovation surveys.

17 The Oslo manual is presently in the process of being revised. The revision is planned to include a wider sectoral scope, including surveying innovation in service sectors. The content of this revision is at present not known.

18 One may still retain an idea of an 'optimal' organisational structure that firms are supposed to learn about, but this organisational structure is treated as a passive function of the technological innovation.

19 This must be distinguished from organisational innovations in the firm-level 'superstructure', like the implementation of multi-divisional organisations, or the M-form, and the organisational innovation of establishing corporate R&D laboratories.

specific user aspects; they are custom-made. The next question is then, of course, whether these organisational changes, or some principles behind them, have general properties that give them some inter-organisational validity, and hence allow them to be diffused between organisations.

The concept of organisational or structural innovations may be extended to point to further shortcomings of a technological mind-set in considering innovations in services. Changes to the architectural structure of a product without changing the core components, architectural innovations in the sense of Henderson and Clark (Henderson and Clark 1990), would probably be characterised as technological product innovations also by the innovating firms when it concerns material products, like a computer or a room air fan. Consider information intensive service providers, such as insurance companies, as the innovating firms. Bundling previously existing insurance products into an integrated product (Gadrey and Gallouj 1994) would correspond to an architectural innovation in insurance. Similarly the innovation of 'junk bonds' in financial services is definitely a new product innovation. Both innovations are not likely to be termed technological innovations, even though they may still be 'technological innovations' in the Schumpeterian sense.[20]

Following Schumpeter, analyses of technological innovation note that innovations are changes to the *existing* portfolio of products and production processes; innovations are considered to be identifiable events in an existing framework of activities. For services with strong customer specificity of the production process, this picture is difficult to uphold, even if the distinction between product and process is possible to maintain.

Together these points entail fundamental challenges to any analysis of innovation in services. It is important to emphasise that these questions remain open in the literature; the present state of our understanding of innovation in important services is clearly limited. It is our aim to contribute to their resolution through future project activities. We conclude this discussion by noting that focusing on *technological* innovation in services may imply a serious misrepresentation and underestimation of change processes in services. Nevertheless the increasing part played by technology, and particularly information and communication technologies, signifies that there are substantial change processes in a wide range of services. The introduction of new technologies may be used as a proxy indicator for these change processes. In the next section we will therefore state some characteristic features of service sectors as regards their use and development of technology.

2.3 Technology in services

As shown by figure 1.3 service sectors are intensive capital users. This is confirmed in figures 2.1 and 2.2. Figure 2.1 compares capital/output ratios of financial services and transport and communication to capital/output ratios of manufacturing, as an

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[20] This points to the difference between the 'common sensical' apprehension of technology - technology as hardware - and the wider meaning of the term that underlies most of the innovation literatures.

(arithmetic) average of G7-countries[21]. The underlying data are given in terms of sectoral GDP measured in 1985 prices, in national currencies by US$ equivalences, to circumvent relative price changes over the period. The figure confirms that transport and communication has a substantially greater capital intensity than other sectors, but that the gap has been declining over the last decades. This implies that the sector includes some of the most capital intensive industries in the G7 economies. Regarding the capital/output ratio as a measure of inverse capital productivity, the figure shows that transport and communication services have had a positive capital productivity growth over this period.

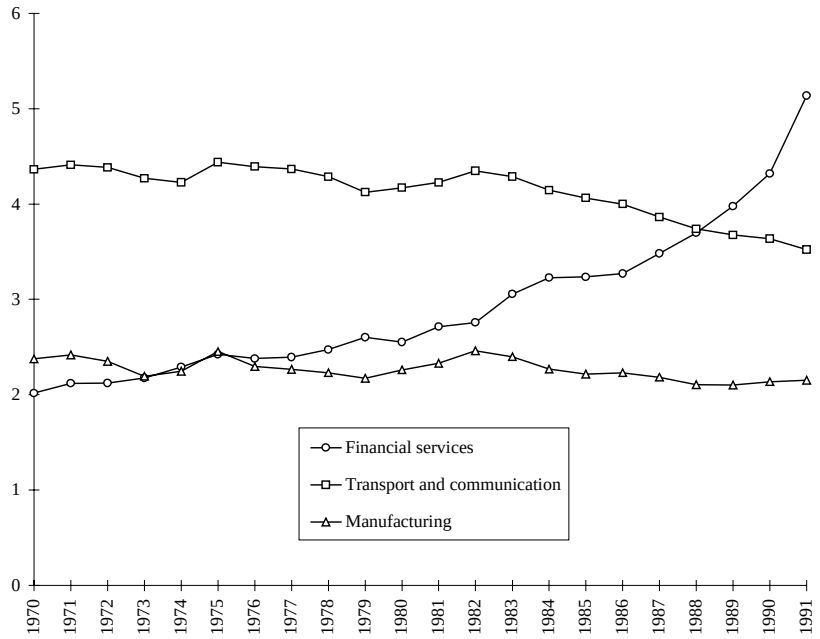

Figure 2.1 Average capital/output ratios G7-countries. Source OECD ISDB

Secondly we note the rapid growth of capital/output ratios in financial services during the 1980s, and that these services on average are more capital intensive than the overall manufacturing average, and even passes the transport and communication average towards the end of the 1980s. This rapid growth reflects the significant changes in these industries as a consequence of new information and communication technologies in the two last decades.

[21] Due to data limitations the figures do not include all G7-countries. Furthermore the different curves do not always reflect the same countries. These figures must therefore be read with caution; they are more suggestive than definite.

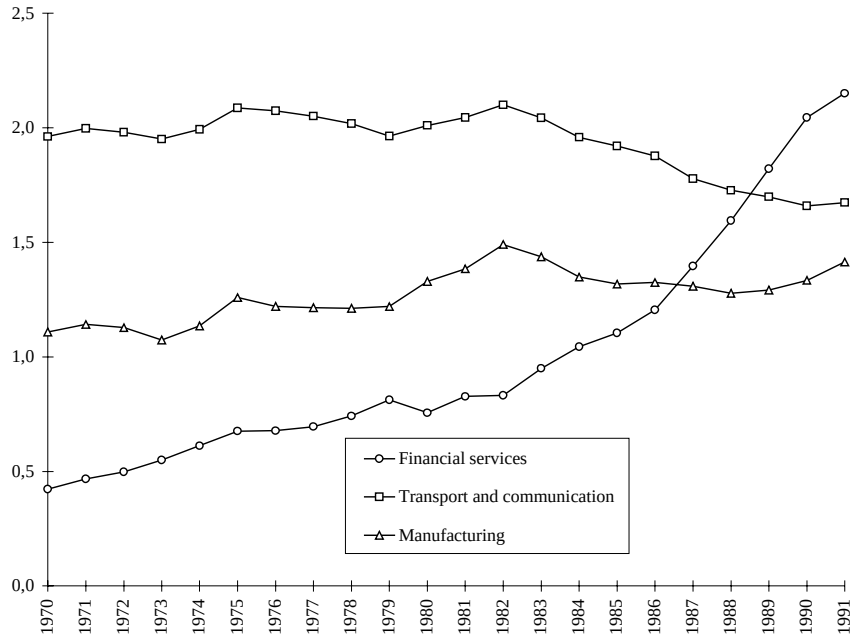

Figure 2.2 Average ratios of capital machinery and equipment to output G7-countries. Source OECD ISDB

Nevertheless, these measures are somewhat misleading as they treat the total capital stock as a homogenous concept. We know that capital structure varies across industries, and particularly between services and manufacturing. One distinction to be made is between capital equipment and goods, and plant investment, mostly tied up in buildings and fixtures. Corresponding to the average numbers used in this section, the share of the gross capital stock represented by capital machinery and equipment, as opposed to plant investments, were 34% in financial services, 47% in transport and communication and nearly 60% in manufacturing in 1985.

These different categories of capital play different productive roles. Hence figure 2.2 gives the capital/output ratios for the same sectors as figure 2.1, with the capital measure restricted to machinery and equipment. The overall picture from figure 2.1 is strengthened; the level of capital intensity in transport and communication is significantly higher in most of the period, only surpassed by financial services in later years. This reinforces the fact that services are responsible for an overwhelmingly large share of IT-investments in several countries. As shown by Roach 1988, more than 80% of US investments in IT hardware were in non-governmental services. The more recent data in table 2.1 are taken from the recent study commissioned by the US National Research Council (NRC 1994). We have excluded government services from the data. Relative to value added and employment the distribution of IT hardware investments has a strong bias towards non-governmental services, particularly for communication and FIRE services.

Table 2.1 US structural distribution of value added, employment and investments in IT hardware, 1991. Adapted from NRC 1994

	Value added	*Employment*	*IT investment*
Manufacturing	21,7 %	21,2 %	16,5 %
Total goods sector	**30,5 %**	**29,2 %**	**17,4 %**
Transportation	3,6 %	3,9 %	2,5 %
Communications[1]	2,5 %	1,4 %	13,7 %
Retail and wholesale trade	17,3 %	26,0 %	22,8 %
FIRE[2]	17,7 %	7,7 %	25,2 %
Other services[3]	25,9 %	30,7 %	13,2 %
Total service sector	**69,5 %**	**70,8 %**	**82,6 %**

[1] Including broadcasting
[2] Financial services, insurance and real estate
[3] Includes health care and delivery, business services, legal services, hotels and recreation

The capital intensity of US service sectors outside trade was nearly 50% higher than the average capital intensity of manufacturing industries in 1985 (Quinn 1987); the service sector capital stock having a growth rate of above 3,5% in the first half of the 1980s, compared to 2% growth rate in the (material) goods producing sectors (Roach 1988). This is in accordance with the conclusion drawn by Ken Ducatel and Ian Miles in a recent study if IT diffusion in Europe (Ducatel and Miles 1994). For the UK the highest spenders on ICT hardware were telecom, banking, retail trade and repair and business services. About 3/4 of investment in computers and telecommunications equipment was in services.

Indicators like these show that there are far-reaching change processes enfolding, beyond the simple view of structural change as a process of shifting labour between a manufacturing sector of rapid labour productivity growth and a labour intensive, productivity laggard service sector. There are simultaneously significant processes going on within service sectors. But the processes in services and manufacturing are not independent; the processes are interrelated through the role played by the increasing technology intensity. Combining this with the discussion of the previous section, we would expect that the strategies individual industries choose to accommodate these changes are highly industry-specific. These points further emphasise the need to understand and conceptualise innovation and change in services.

We may note that there seems to be a paradox when we compare changes in capital stocks of services, figures 2.1 and 2.2, and development of labour productivity. To the extent that capital stocks have generally been growing, paralleled with a change in composition, we would expect a (relative) increase in labour productivity.This does not seem to be the case. As we will see in chapter 4, changed IT-intensities lie behind this compositional change. This is one aspect of the so-called ‘productivity paradox’ (see f.i. several contributions to the OECD conference on technology and productivity,

OECD 1991a, as well as the final reports from the OECD TEProgramme, OECD 1991b and 1992b).

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

Table 2.2 Services and technology - the main hypotheses

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

Services are often characterised as being supplier dominated, referring to Keith Pavitt's sectoral classification of innovation trajectories (Pavitt 1984). This would mean in particular that their technological innovation trajectory is dominated by suppliers of capital equipment, with innovation pre-eminently being capital-deepening and labour-saving process innovations. Industries that are characterised by supplier dominated technological trajectories have a significant overrepresentation of small firms, that primarily appropriate innovation benefits through non-technical methods, such as marketing, aesthetic design and reputative mechanisms.

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

One immediate indication that suggests the inadequacy of the 'supplier dominance' approach to services is the evidence underlying the patterns in figure 2.2. The capital intensity of financial and communication services imply that these sectors include some of the most capital intensive industries, and hence dominant technology users, in the G7 economies. If this is the case it is highly unlikely that they do not play a substantial role, directly or indirectly, in the shaping of the technologies in which they are heavily involved.

The supplier dominance of services is being challenged by other indicators as well. It is only during the last few years that systematic efforts have been made to cover selected service sectors in the national R&D surveys in OECD countries. Fifteen years ago the general attitude was that the mismeasurement that this created was not substantial; estimations based on the R&D statistics indicated that services represented in the order of 5% of national business sector R&D. During the 1980s this situation changed dramatically. As business service sectors were included in the surveys, the services' share of business R&D expenditures quickly rose to 20-25% in several countries, making knowledge intensive business services the largest source of intermediate embodied R&D.

Figure 1.2 suggests, and it is evidenced by other indicators, that services are major destinations for scientists and engineers, especially but not only in ICT specialisations. Particular services are heavily involved in the flow of technological knowledge through the economy and society. The strengthening of interactions between manufacturing and service sectors is common to many European economies. By virtue of their wide network into business sectors, some services with a strong technology or knowledge component may play a pivotal role as vehicles for diffusion of new technologies throughout the economy. Being major employers of scientists and engineers they will also be a major source of specialist knowledge and for access to advanced networks.

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

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

Knowledge and technology infrastructures seem to be less adapted to the needs of services than to those of agriculture or manufacturing. More informal innovation processes reduce service organisations' ability to articulate their needs for strategic research relative to their manufacturing counterparts, creating a Catch 22 for intensifying the relations between service sectors and the public infrastructures. The informality may be due to service innovation requiring a wider integration of technological, organisational and social factors, as indicated above. The knowledge bases of some services appear to be more diversified and diffuse than knowledge bases of typical manufacturing industries. But it is probably also a consequence of the less clear-cut industrial structures, implying relatively more weakly developed industrial superstructures, like industrial associations and networks, industry-based

interaction with public authorities etc. For new service sectors the situation is a fluid, ever-changing industrial structure[22]. This in itself raises important questions for policy formulation as regards its level of attention.

In spite of lesser formalised R&D and innovation activities in services, there is strong evidence that some services are as R&D-intensive as most manufacturing sectors. The non-technical appropriation of service innovations, combined with a weaker role of intellectual property rights (IPRs), could imply that these innovations are more susceptible to copying and imitation, implying a significant disincentive to innovate in services. The recent case studies of knowledge intensive business services performed by TNO and PREST (Bilderbeek & al 1994) has shown, however, that a large number of 'strategies' or 'regimes' have been developed to ensure profitability of service innovation.

Our conclusion may be summed up as follows.

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

2.4 Main challenges for future research

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

An in depth study of knowledge intensive business services would provide further insights into the role of services in the generation and diffusion of innovations. Such a study should emphasise,

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

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[22] We suggest that this is due to a weaker industrial culture or identity, particularly in new services. What distinguishes several manufacturing industries, as well as established service industries like banking and insurance, trade and transport, is an, often prominent, industrial culture, or 'mind set' (Phillips 1994), a culture that has developed over several decades. What characterises new, often termed dynamic, services seems to be a weaker industrial identity. Professional cultures and networks may play a significant role.

The ‘industrialised’ countries are already advanced service economies. Typically service sectors represent more than two-thirds of employment. A substantial fraction of the value-added in these countries originates in service sectors. Industrialised countries are undergoing significant structural and socioeconomic changes, with services playing an important role in these changes. Many sectors of economic activity are running through phases of rapid internationalisation and globalisation, restructuring competitive markets and potentialities for growth. International integration and processes of national deregulation imply changed ‘rules of conduct’ for previously nationally based service activities.

With these aggregate trends it is paradoxical that service activities is a blind spot in many national innovation and technology policies. It is important to resolve this, for the industries themselves and to allow formulation of relevant innovation policies. The activities we suggest will allow development of recommendations for the formulation of national innovation policies, with a scope that encompasses the complementarities between different economic sectors. By mapping services’ roles towards innovation and change and studying their implications, the results will also be valuable to the business community as a background for formulating and implementing innovation and management strategies.

3 Services in the economy

3.1 What services are (not)

We have already noted the heterogeneity of the class of 'service' activities in section 1.2. Nevertheless these activities are in everyday parlance and political discourse often treated as a class of activities that have important characteristics in common, *viz.* characteristics that purportedly describe their social role in some unified fashion. These characteristics mainly focus on their immateriality and 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, at the bottom line, 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.

Initially we note two aspects of such negative assessments of services. Even though such characterisations are rampant, we are happy to buy and consume the services produced by modern service industries, also valuing the increased social equity in access to such services implied by a significant fall in prices of these services relative to average income.

Secondly the characterisations usually refer only to (production for) final consumption. Production of material intermediate or capital goods for these service industries are still 'welfare' or 'value' generating; they are productive. Furthermore, intermediate service production is also regarded as part of the productive system, they are participating in a material production system. Hence this assessment is not applied to services in general, or to all tertiary activities, but rather to a subset of these.

In this chapter we attempt to trace the origins of such characterisations to classical political economy; the economic theory building of the 19th century. More specifically, we argue that the basis for these assertions is a materialist conception of economic and social processes. In doing this we show that such allegations are in fact inconsistent with the modern basis for political reasoning about economic change and socio-economic policies. To do this we will give a brief interpretation of classical economic thinking on a related issue; the identification of productive activities in the economy.[23]

Elsewhere (Hauknes 1996) we have described the development of the concept of services in classical and neoclassical economics, to trace the origin of such characterisations of services' economic roles (for a presentation of services in classical and neoclassical economic theory, see Delauney and Gadrey 1992). Many of

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[23] The presentation will suggest a stronger consistency than was actually present in classical economic thought; it is a construction of a classical synthesis. However, some inconsistencies to a modern eye are only apparent; they stem from the different perspectives of modern economics and classical political economy on how commodities acquire price/value.

these general apprehensions of services are rooted in a context of classical 'political economy', a context that differs from the marginalist and neoclassical 'economics' context on critical aspects. Such apprehensions may be traced back to the classical delineation of the economic system, *viz.* the capitalist economy, from the social system within which it was embedded.

The prime aim of classical political economy was to develop an understanding of the development of the then modern industrialised capitalist society; the objective was to describe and understand the 'equations of motion' of the capitalist system. An important first part of revealing the 'equations of motion' was distinguishing between productive and unproductive activities in a specific and rather technical sense. The core outcome of the economic or capitalist system was national 'wealth', a productive wealth in the sense that it was also the generator of further accumulation of wealth.[24] Hence the distinction between activities that contributed to the accumulation of permanent, or material, wealth[25], and those that did not, was central to enable the economist to identify the *economic* system and to reveal the 'laws of economic motion'.

Being productive, an activity contributed to the creation of "permanent utilities, whether embodied in human beings, or in any other animate or inanimate objects" (Mill 1868).[26] It is in this sense that Adam Smith's (Smith 1979) well known dictum of the menial servants, as well as of "others of the most respectable orders in society ... servants of the public … churchmen, lawyers, players, buffoons, musicians, opera singers"; must be interpreted. Since their production "generally perish in the very instant of their performance, and seldom leave any trace or value behind them", they cannot contribute to the accumulation or creation of permanent wealth.

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24 But still it is not crystal clear what is meant by the concept of wealth by different writers. Karl Marx does not use the concept, what plays the role in his system is his theory of capital accumulation, the generating power of wealth is played by industrial capital in his system. This position is close to some of Adam Smith's formulations about wealth.

On the other hand, Mill, who is often regarded as the ultimate synthesiser of the classical political economy, used a much wider concept. Wealth is

> "all useful or agreeable things which possess exchangeable value; or, in other words, all useful and agreeable things except those which can be obtained, in the quantity desired, without labour or sacrifice" (Mill 1868, p. 6)

25 On the origin of the materiality, John Stuart Mill's (Mill 1868) synthesis is revealing. The central feature of wealth is that it makes a difference, a difference that is intransient; it is 'permanent'. This definition does not require materiality. Nevertheless, from this wide definition John Stuart Mill reduced his concept of wealth by reference to 'popular apprehension'; wealth is "only what is called material wealth, and ... productive labour only those kinds of exertion which produce utilities embodied in material objects", in spite of him stating his principal preference to permanency rather than materiality.

26 The extent to which this makes the productive/unproductive (or equivalently 'material'/'non-material' in the above sense) approach untenable as a classification of services is shown by a simple example. Consider the example of personal transportation; the distinction would make business travel a productive activity, while private travels would be rendered unproductive.

The central outcome of the 'classical economic system' is wealth, with a traditional materialist 'mind-set' interpreted as material wealth. The economic circulation producing material wealth must then also include consumption; but only that part of consumption that regenerates the productive capabilities of the work force (as well as of the capitalists!). This is the only 'productive consumption'; all other forms of consumption are unproductive, *i.e.*, not participating in the wealth-generating circulation; in national or social wealth-creation[27].

We may then draw two conclusions from the classical materialist stance of economic productivity. A first distinction may be made between two categories of final consumption; between consumption of material and of immaterial consumables. Since it cannot contribute to the regeneration of the (material) productive capabilities, the latter category resides wholly in the sphere of unproductive activities, by implication, so too does production of these consumables. On the other hand immaterial production may be productive: it would definitely be wrong to claim that all production of immaterial goods is unproductive. Distributive services such as goods transport and trade f.i. were naturally included among the productive activities by the classical economists. Any activity, whether material or immaterial, that contributes to the production of material goods *qua* vendible commodities[28] (creating a surplus value of the goods, through altering their physical or economic characteristics), is potentially productive.

That is, consumption of services that are materialised in or partaking in the constitution of valuable and material economic good, and hence the production of these services, is productive as long as it contributes to the regeneration of productive capabilities. But by the same logic, all final consumption, whether material or immaterial, by providers of unproductive services is equally unproductive. Thus the class of unproductive activities is not synonymous with services, in fact both productive and unproductive activity spheres include both manufacturing and service activities. But it definitely implies that production and consumption of final services are unproductive.

Today several service activities, far beyond Adam Smith's menial servant, are classified as unproductive, in a sense that resembles this technical classical sense. That is, it is not services *per se* that are unproductive, but rather the part of service production that do not contribute to capital accumulation, epitomised by final market services. In particular, this is the position of Cohen & Zysman 1987; production chains that ultimately produce material final consumables is the decisive factor; what matters is manufacturing. We conclude that there are strong parallels between the

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27 Creation of wealth, a level concept, is a 'classical' concept that has been substituted for by flow concepts in 'marginalist' economics. The concept of wealth creation is used in policy documents, cf. f.i. the UK 1995 Competitiveness White Paper, "higher living standards for our families, better schools and hospitals, strong defence, a cleaner environment, and a thriving artistic and cultural national life all depend on wealth creation" (HMSO 1995).

28 Focusing on a materialist economy is therefore a limitation of classical political economy, as it identifies the reification that the status of being a vendible commodity implies with material reification. In modern parlance the discussion would focus on the economic properties of excludability and rivalry, a point to which we will return briefly below.

'modern' materialist conception of services and the classical delineation of the capitalist system. Hence we may say that the classical concepts are the early origins of the perceptions of services as unproductive.

There are three comments to be made. First this 'modern' reflection fails to take on board the full impact of a classically based argument. Secondly, probably reflecting this, there has been a shift in the interpretation of the term productivity, from being a technical term to having normative connotations. Lastly, this conception would seem to fail to take into account the development of economic thought after 1870.

After the death of J.S. Mill, the productive/unproductive dichotomy lost its potency due to the changed understanding of the economy and the new scientific program of economics. With 'marginalist' economics the need for the distinction disappeared, and Alfred Marshall could assert that the term productive, in the classical meaning, is unnecessary, "all the [classical] distinctions in which the word Productive is used are very thin and have a certain air of unreality ... it is probably better that they should dwindle gradually out of use", *all* labour except that "which failed to promote the aim towards which it was directed" should be declared as productive (Marshall 1920). By saying this, Marshall gives the term productive its modern meaning of *productivity*; as production efficiency and not as a ranking, often perceived as normative, of economic activities.

But then it follows that distinguishing material from immaterial goods, as services, is irrelevant from the perspective of economic theory. 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.[29] Unless one generalises the market concept,[30] this evidently restricts focus to services provided through open market transactions.

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

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29 There may still be a dependency of transfer properties on characteristics like materiality; as the possibilities of maintaining property rights. More specifically, for information intensive service products, the properties of information as to primarily rivalry, but also to some degree excludability, restricts their transfer qualities, and hence the characteristics of markets in these products, cf. f.i. Hauknes 1994a.

30 This generalisation could be made to encompass both public services, and intra-firm provision of services. Whereas the first require a considerable reconceptualisation of market concepts (though not outside the scope of economics), the second generalisation is often made in terms of *transaction costs* and institutional economics (Coase 1937, Williamson 1985). The latter raises fundamental questions about our present understanding of why firms exist, cf. Arrow 1974, in the context of services see f.i. Hauknes 1996.

It is no surprise then that the 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. Even a well-versed analyst as Sven Illeris finds it necessary to stick to the "traditional definition [that s]ervice/ tertiary activities are those which do not produce or modify physical goods" (Illeris 1989), a definition that seem to imply either a severe restriction of the category of tertiary activities or restricting it to physical, or material, modification of material goods. The 'best' suggestion of a definition is 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. It may be read as a sarcastic comment to the indeterminacy of service definitions.

In addition the term 'service' itself has many connotations, both in terms of its meaning[31], and because of the human ability to operate simlutaneous 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. This 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 the emphasis 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. A publisher does not produce books, she provides a service - a learning and reading experience - or an adventure. This last service concept is evidently based on integrating and legitimising the production of the good with the customer's satisficing of wants - it is so to say venturing into the utility or preference function.

This implies a need for caution when approaching management literatures on services, as these often reflect such apprehensions. Analysing and quantifying 'service content' of manufactured products may reduce to senselessness if it involves substituting internal self-apprehensions with externally perceived service characteristics. Equating service content as anything associated with producing the product beyond the 'bare' physical necessity or modification involved in the product involves a fictitious baseline. Evidently this conception of a completely 'service-free' product is meaningless;in discussing the roles of service functions in production it is necessary to have a more nuanced approach. Furthermore it implies that definitions of service functions and sectors cannot rely on the producers' perceptions of their own business activities; it must be based on an objective functional classification.

Our approach will be to treat services as a rather fuzzy set, albeit with a functional classificaton as a basis. What we include as service functions will, reflecting the indeterminancy, not be defined in a precise way, but it will correspond broadly to what are usually regarded as service sectors. The inordinance of pursuing any precise

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31 The Webster's dictionary gives close to 20 different meanings of the word, several of which may be relevant for interpreting the service literatures.

definitions follows directly from what has been said above. Simultaneously it underlines the need to develop better concepts to describe the various characteristics of different services.

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 relevance to our topic is immediate, as the constitution of service markets will form one significant determinant for the mechanisms of variety generation and selection that underlies the link between innovative behaviour and its 'reshuffling' effects on the economic agents; *viz*., the service providers and users. We will discuss some of these features in the next section, noting what has been termed the 'peculiarities' of services.

As we have seen, the immateriality or intangibility[32] of service products cannot form the basis for an economic classification of services. However, two features, being 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, often with a strong element of customisation.

Together they are frequently used to emphasise coterminality of production and consumption as a characteristic aspect of many services. The ephemerality condition, and the implied non-storability, as a general economic characteristic of services seems to involve the materiality condition in disguise, confusing the exchange of the right to a utility generating agent (the product), with the process of utility generation. Customisation 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' coproduction is distinctive, but it is not clear from the literature how large this class is, when considered as a class of economic activities. But even though neither are constitutive in themselves, they evidently may have considerable effects on the market structure, a high degree of customisation may contribute to creating 'local monopolies'.

Similarly it may be claimed that services have a different scale-intensity than manufacturing production. This seems to be true in a rather vague sense, even though the claim presupposes some sort of typical manufacturing scale-intensity. It is possible to distinguish different modes of scale-intensity in manufacturing production, classifying different manufacturing production processes according to some measure of scale-intensity, as envisaged in figure 3.1, in five generic production process types; project, jobbing, batch, line and continuos process. The figure indicates a close negative correlation between product variety and production volume.

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[32] including non-storability of services.

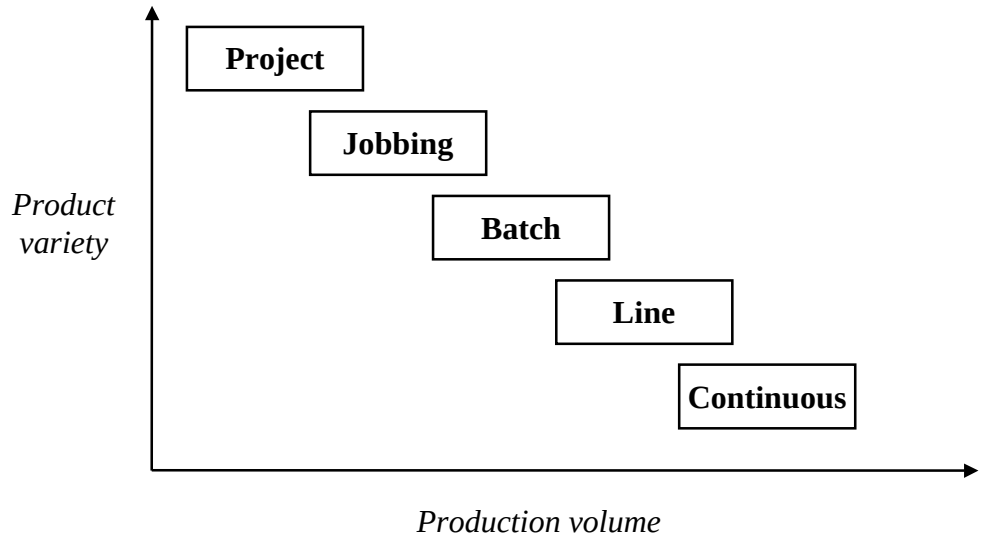

Figure 3.1 The product-process matrix - generic production processes. Source Silvestrou & al 1992

The five process types are, according to Hill 1985 (as cited by Silvestrou & al 1992), distinguished by product range, customer order size, degree of product change accommodated, ability of operations to cope with new developments, orientation of innovation, performance criteria, nature of process technology, number and expense of set-ups and quality control. It is important to note that although some production processes over time may slide 'downwards' between process types[33], this is a characterisation of different manufacturing activities; it is not a causal model of industry cycle processes.

In attempting to apply these characterisations to several services, one quickly meets the question of measurability of output; both product variety and volume require an ability to measure characteristics of output from the production processes. The problems of measuring output in several services (see f.i. Griliches 1992) cast doubt on the applicability of a scheme like this on several services. Should one insist on using the pattern as a model of industrialisation, it would definitely be premature to apply this model to several, perhaps primarily information-intensive, services. We are only at the beginning of a potential process of industrialisation of such services, and there are no reasons to believe (on the contrary, there are good reasons to disbelieve) that these processes will resemble industrialisation processes in other sectors.

The approach taken by Silvestrou & al 1992 is to use a set of criteria that may be said to mimic the variety/volume pair of figure 3.1:

- whether the service is equipment- or people-based, with technological equipment constituting the service, being the 'service-carrier' (Carlsen and Wulff 1994) of equipment-based services,
- customer contact time per transaction,

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[33] It seems that this would be the outcome of an Abernathy-Utterback product cycle model (Abernathy and Utterback 1978), with the reduction in product variety corresponding to the evolution of a dominant design, ending up in the high-volume, low variety line or continous process production.

- degree of customisation,
- the extent of service design exercised by front-office; i.e., customer contact, personnel to meet individual needs, relative to back-office design,
- back-office to front-office staff ratio,
- product- vs.- process-oriented focus,

as measures corresponding to variety, and the number of customers processed by a typical service unit in a given time period as a volume measure.

Based on a set of case studies, Silvestrou & al propose the model depicted in figure 3.2 as an alternative to the model in figure 3.1. It distinguishes between three different service production modes; professional services, the service shop and mass services:

- *professional services*, covering activities like consultancy and engineering; highly customised, front-office dominated services with a process-orientation (i.e., focus on user-adapted service delivery),
- *service shops*, encompassing hotels, retail trade and banking and rental services, with a mixed focus, and
- *mass services*, like transport services, with high volume, little or no customisation and a predominant service product orientation.

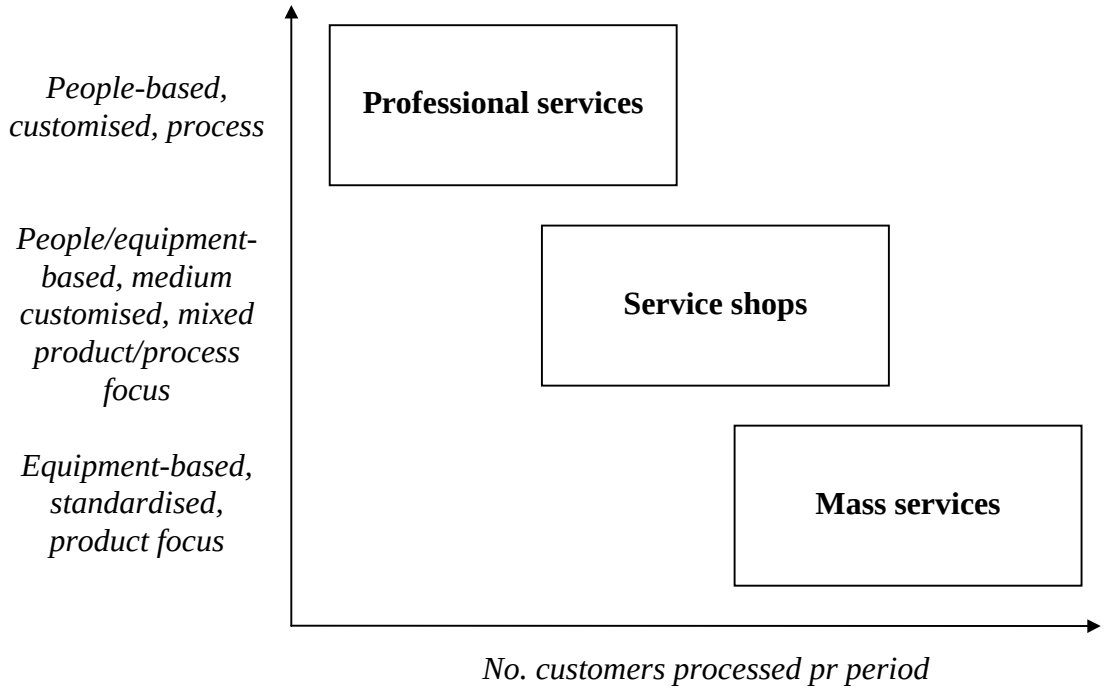

Figure 3.2 Generic service production processes. Source Silvestrou & al 1992

Again the outcome is a fairly consistent negative correlation between a composite measure of variety and a volume measure. In addition there is a fairly stable positive correlation between the individual measures contributing to the aggregate variety measure.

As with the product-process matrix of generic manufacturing production this may be interpreted as a rough indication of market structures. High variety (high customisation) and low volume may correspond to localised monopolies, pending entry barriers, while mass services with high volume standardised production may have scale dependencies that create opportunities for wider oligopolies. Intermediate industries as service shop dominated ones, may enable market structures resembling perfect markets; dependent on 'tradability' and scale dependencies.

We will not discuss any specificities of the multitude of alternative definitions, instead referring the reader to the literature. See f.i. Gershuny and Miles 1983, Howell and Green 1988 and Illeris 1989. We will note however that attempts to define services as a homogenous subclass of economic goods, or simply 'goods', as it is often wrongly expressed[34], are deemed to be incomplete, inconsistent or restrictive in terms of what is considered services. To our knowledge no approaches to analysis of service products and services has tried to classify services in terms of their products exchange properties, apart from their obvious use on the economic properties of information and knowledge. Even though the extent of excludability and rivalry that may be associated with different types of services have decisive impacts on the properties of service markets, and hence on the character of the competition, none has as yet attempted to discuss how this affects innovation processes and strategies at firm level.

We may ask whether it is possible to devise a 'meta-classification' of different approaches to the classification of services. At the outset it seems that there are several criteria on which such a meta-classification may be based, such as,

- the exchange properties of service products noted above,
- service market qualities,
- functional characteristics of services,
- activity specific characteristics, 'tertiary' activities,

[34] Services are *economic* goods, just as ... material goods, satisfying wants, i.e. creating utility, and of which there is scarce supply. A good/non-good dichotomy is not able to distinguish manufactured goods and services. An approach through the exchange or transfer properties seems more fruitful, but then appraising the heterogeneity of what would be termed service products is tantamount to acknowledging the variety in these properties. Even though services may equally well be incorporated in a barter economy, it is even possible to envisage some types of services as commodity money; properties of excludability and rivalry open up for considering a continuum of economic properties, distinguishing between different categories of economic goods.

Table 3.1 Categorisation of industrial sectors as service sectors.

Author / *Sector*	*Fisher 1935*	*Clark 1941 (1. ed)*	*Fourastié 1949*	*Clark 1957 (3. ed)*	*Kuznets 1966*	*Fuchs 1968*	*Gershuny 1978*	*Stanback 1979*	*Gershuny /Miles 1983*	*Petit 1986*	*Daniels 1993*	*NRC 1994*
Utilities				*								*
Construction				*								
Trade	*	*	*	*	*	*	*	*	*	*	*	*
Transport	*	*	*	*					*	*	*	*
Communication	*	*	*	*					*	*	*	*
Financial and business services	*	*	*	*	*	*	*	*	*	*	*	*
Other services	*	*	*	*	*	*	*	*	*	*	*	*
Government	*	*	*	*	*	*	*	*	*	*	*	*

- aspects of service production processes,
- occupational structures
- contingencies and substitutability with manufactured goods.

In addition there is a need to clarify whether the classification aims at describing service activities, irrespective of organisation, or at classifying service sectors or firms. The multi-dimensionality of any such classificatory exercises is immediately evident. The fluidity of the situation may be illustrated by table 3.1, adapted and expanded from Delauney and Gadrey 1992. Some industries are considered service or tertiary activities by all authors, notably wholesale and retail trade, FIRB services, the category of other services, including health and personal services, as well as the activities of the government sector (excluding governmental enterprises which are considered to belong to the industrial sector corresponding to its activity). Transport and communication are considered to belong to an intermediate category of industries, either corresponding to their integrated position versus manufacturing industries or justified in terms of their capital- or technology intensity (as f.i. in Stanback 1979).

Table 3.2 The Singelmann classification of services

Service sector	Service industries	NACE Rev. 1	
Distributive	Transport and storage	I	60-63
	Communication	I	64.2
	Wholesale and retail trade	G	50-52, exc. 50.2, 50.4, 52.7
Producer	Bank, insurance and other financial services	J	65-67
	Real estate	K	70
	Legal services	K	74.11
	Accounting	K	74.12
	Engineering and architectural services	K	72-74
	Misc. business services		
Social	Medical/health services and hospitals	N	85
	Education	M	80
	Postal services	I	64.1
	Government	L	75
	Other professional and social services		
Personal	Hotels and restaurants	H	55
	Repair services	G	50.2, 50.4, 52.7
	Entertainment and recreation	O	92
	Other personal services		

The consensus that seems to emerge from table 3.1 reflects straits from the by now widely acknowledged industrial classification of Singelmann (see f.i. Browning and Singelmann 1978). The Singelmann structure provides a classification of industrial sectors based on functional categorisation, split between six broad industrial sectors, *viz*., extractive, transformative, distributive service, producer service, social service and personal service industries, four of which are categories of service industries. As a classification of all industrial activities, it was also devised as an alternative to the

UN ISIC framework; it seems to be the main alternative to the ISIC/NACE standard, apart from national systems like US SIC. The four service classes are detailed in table 3.2, together with a suggestive concordance with the European NACE classification.

As shown by the amount of effort put into the attempts to define and characterise services, it seems reasonable to conclude that what we call the service or tertiary sector is so diverse that the value of looking for a coherent and unique (positive) characterisation of this sector is marginal. It seems that John Stuart Mill's conclusion still remains valid, "I have made little use of the popular distinction of industry into [primary, secondary and tertiary[35]]. For, in truth, this division fulfils very badly the purposes of a classification" (Mill 1869).

A better strategy seems to be to start with the diversity, and characterise sectors of service activities on their own terms. The limitation is of course that we fall victim of the well established use of the term 'services'. We will frequently use the term services in this wide sense, but it must be understood as simply a common label for this diversity of activities, functions and products.

3.2 Service characteristics

3.2.1 "Peculiarities" of services

Several characteristics of services suggest that they must be expected to behave differently from the archetypes of economic goods we are brought up to think in terms of, a number of which we noted in the previous section. But in contrast to the discussion there, our aim is no longer to *define* services through them. The approach we will take is that those sectors commonly referred to as services comprise a widely disparate set of economic activities, with the heterogeneous properties having varied consequences in terms of market characteristics. The role some of these sectors seem to play in the dynamic processes currently changing the state of industrialised economies, make it urgent that we understand the way these sectors develop and change. To enable such understanding we need to understand the qualitative features of these service sectors and how these affect market structures and competitive forces promulgating innovation processes.

Some of the characteristics we will note may indeed have consequences for the economic properties of such service products; relating to their exchange properties as economic goods. Some observers have called these characteristics *'peculiarities'* of services (e.g. Miles & al 1995), setting them off from a perceived normal state of affairs, the normality evidently being the antonym of the described characteristics. We note some of these 'peculiarities' in table 3.3. The classification in the table distinguishes between service product, production process, markets and consumer/user-producer linkages. Evidently some of the features are difficult to position in such a scheme, because of the interdependencies between them.

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35 Mill's sectors are "agricultural, manufacturing and commercial".

Table 3.3 Peculiarities of services. Adapted from Miles & al 1995 and Sundbo 1994a

Service product	∗ *Immaterial/intangible* ∗ *Changing 'social'/'informational' state of products, persons or information* ∗ *Valuation = labour inputs* ∗ *Non-storable* ∗ *Non-excludable* ∗ *Non-rival* ∗ *Custom-made* ∗ *Product quality dependent on consumer quality* ∗ *Information dense*
Service production	∗ *'Footloose' production* ∗ *Capital structure* ∗ *Craftlike production* ∗ *Labour intensive* ∗ *'Interrupt' ('on demand') production* ∗ *User intensive and co-spatial* ∗ *Limited scale economies* ∗ *Material intermediate inputs either very high or very low* ∗ *Bundled with other production* ∗ *Apparent weak incentives to change*
Service markets	∗ *Services have use-value, but not exchange-value* ∗ *User-producer integration making production, transaction and consumption indistinguishable* ∗ *Distribution in closed networks* ∗ *Untransportable* ∗ *Non-exportable* ∗ *Appropriation difficult* ∗ *Not 'resellable'* ∗ *Duplication easy; marginal cost of production negligible, no usual market price* ∗ *Price as direct compensation of labour inputs* ∗ *No transfer of property rights* ∗ *Problems of demonstrability and marketing* ∗ *Public and professional regulation*
Service consumption	∗ *Trust in user-producer relations* ∗ *Consumed while produced* ∗ *Consumed where produced* ∗ *Consumer specific utility* ∗ *Satisfying psychological wants* ∗ *Producer integrated*

The table must be read as 'features often (claimed to be) characterising services' and must be read as a menu of such peculiarities. Some features can be recognised from the framework described in section 3.1. Others are new, but are recognised as features shared with other economic activities. Others again are of a more 'technical' nature, such as consequences of the difficulty to measure outputs in some service industries. Several of the points made in the table refer to characteristics that are defining features of 'public goods' (non-excludability and non-rivalry), of 'infrastructures' (as zero marginal cost combined with large fixed costs of production). Several of the features are mutually dependent, or even complements, across the division, as related to appropriation and excludability, or corollaries of the consumed when and where produced thesis. Two aspects are shared by several of these 'peculiarities'; the intangible, often meaning information intensive, character of many services, and the intensity of the relation between producer and user, as the coterminality/cospatiality conditions.

We note immediately that several of these peculiarities refer back to the four aspects we considered in the previous section; materiality, economic exchange properties, ephemerality and intensity of user-producer linkages. In particular there seem to be three main characteristics that emanate from the table:

- 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[36],
- 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.

An assessment of these features in terms of their consequences for economic properties and structures is beyond the scope of the present work, but it seems to be vital to focus on these questions as a strategy for disclosing the economic dynamics involved in the structural processes in advanced economies, as well as to understand innovation and change within different service sectors. In the next section we will briefly note some of the questions that this raises, but without answering them.

3.3 Economic properties of services

We will not consider whether the individual 'peculiarities' noted above are valid or not, or to what kind of service activities they apply. What we will say in this section of economic properties of services will be suggestive, rather than definite. 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

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36 Property rights, or (future) rights to use, relates to the institutional framework of economic transactions, and not to inherent properties of the economic goods (though they may of course have implications for the design and conditions of implementing property rights).

- the conditions for implementing changes in service industries.

and the way we conceptualise these structures and changes. Furthermore, these characteristics reinforce the consideration of heterogeneity; the necessity to treat different services differently, to distinguish different service production process, and to distinguish between service 'delivery systems' and service provision. One way of approaching this is suggested by the framework of Silvestrou & al 1992, which also to some extent distinguishes between standardised - or standardisable - and customised services. The higher standardisation of mass services implies the possibility of a commodity character of some services, with quite general exchange properties, whereas customised services could in principle participate in barter trade, but are difficult to envisage as commodities.

We suggest as a hypothesis that the most substantial difficulties in developing an 'economic theory of services' are related to 'professional services', especially to knowledge- or information-generating services. The character of these services imply a serious information problem, with a weak role for prices as information carriers, and a stronger localised character, through co-terminality and co-spatiality, of service activities. This will have dramatic effects on market structures, such as through possibilities of creating local monopolies (Petit 1986). On the other hand features such as weaker appropriation regimes, smaller scale, footlooseness and information intensity indicate lower entry barriers, and hence the possibility of even more intense local competition.

Distinguishing between services for final consumption and intermediate services, a focus which goes back to classical economics and the distinction between productive and unproductive labour and consumption, is relevant. There are good reasons to believe that particularly knowledge-intensive services with a strong element of 'customisation' are primarily of relevance as intermediate inputs, that is, they are dominantly knowledge-intensive producer, or business, services.

We may conclude that there are significant reasons for questioning the usual assertion of stagnancy of services' productivity development. We will substantiate this further in the next chapters when we will discuss issues relating to innovation in services. As the main instigators of innovation processes are competitive pressures of cost-efficiency and product differentiation - *viz*. the technological competition complementing the price competition of neoclassical markets - the presence of innovation activities in service sectors does not only lead us to expect a resulting productivity growth in these sectors, but it also proves that the actors themselves perceive scope for future productivity change and for making this an objective for company strategy.

But the concept of productivity is difficult to operationalise in service (as well as in some manufacturing) activities and industries (Griliches 1992), particularly in activities experiencing rapid qualitative change, with a large degree of 'customisation' or with a strong producer-user integration. These aspects of economic activities emphasise to varying degrees the difficulties in distinguishing between traditional 'throughput' measures of productivity on the one hand and 'service bundles' or consumer utility on the other. This is a point to bear in mind when considering various productivity measures.

Nevertheless there is no doubt that service firms are exposed to similar competitive pressures to manufacturing firms, that is, to economise on the use of various factor inputs by designing 'production processes' in a cost-efficient way that at least keeps in step with the general development of major competitors. Now there are various ways service and manufacturing firms may choose to do this, depending on factors as varied as design features, structure and competitiveness of markets and regulation, and structural characteristics, both at firm- and industry-level, capital structures, and scopes and opportunities for improving these. The prospects for strategy choices are shaped by internal features through the firm's ability to learn, its receptiveness towards the environment. This points to the importance of two interrelated concepts in innovation literature, the firm's 'absorptive capacities' (Cohen and Levinthal 1989), its ability to adopt, mould and develop innovations, and the attentive availability and augmentation of complementary assets (Teece 1986).

At the same time, elements of customisation should not be overstated. In significant service markets there is still considerable standardisation in product portfolios, particularly, but not solely, in terms of services provided for final consumption. An example in case might be retail banking, where household consumption of services is largely restricted to a limited set of standardised bank services. Thus in sectors like these, the character of competitive pressures should resemble those in other industries in 'standardised' markets, though the qualities of service products may lead to other kinds of innovation strategies.

The consequence of this is that we would expect to see broadly similar development patterns of employment in service industries dominated by standardised product portfolios as in comparable manufacturing industries. The similarity is most notable in terms of the relation between resp. capital-widening or capital-deepening investment and innovation strategies on the one hand and labour-enhancing or labour-saving productivity strategies (cf. discussion in following section). In manufacturing sectors this is often presented in the context of a description of a 'product cycle' (Abernathy and Utterback 1978), describing the industry running through phases from initial dynamic growth based on radical product innovations and significant capital widening investment constituting new industries to incremental process innovations, contingent with capital-deepening investments in mature industries[37].

As we shall see later there have been attempts to develop a similar cycle concept for service industries, cf. section 6.2 (Barras 1986, 1990). The striking feature of this proposal of a service cycle is that it runs the Abernathy-Utterback cycle backwards, which would immediately predict a different cycle pattern over time in these sectors' employment trends and industrial structures.[38]

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[37] For this reason the cycle would have been better termed an *industry* cycle than a product cycle.

[38] In fact Barras presents his ideas as the general pattern of development in industries that are users of externally developed technology; industries where technology import forms the basis for incremental process innovations. Hence the Barras cycle may be reconciliated with the

There is of course, also a role for demand patterns in this. It is likely that the consumer perception of material and immaterial goods differ, and that this in itself affect demand patterns, even when the service/utility provided by the product is fully substitutable across the material/immaterial interface. This would imply that service and commodity demand would evolve differently, imparting a difference in terms of the development of industrial production. It has been claimed that one of the principal differences between European and US consumption patterns is the US consumer's propensity to prefer the possibiity of exerting ownership over a piece of good[39]. If this is so, the evolution of demand patterns would presumably be different.

3.4 Service functions and service sectors

A widely discussed theme is the interface betweenthe goods manufacturing and services; in the strategic management literature, as f.i.Quinn 1992, in economics and analysis of structural change, see Pascal 1986 and in analysis of the role of specific service functions towards manufacturing industries, f.i. Porter 1990.

As is generally acknowledged, it is impossible to conceive manufacturing industries without taking into consideration a huge amount of services; to apprehend manufacturing production without considering a substantial service component. Manufacturing is becoming increasingly services dependent and an increasing share of service companies are integrated into networks with other economic sectors. There are also strong linkages between goods and services arising out of the complementarities of demand. This integration implies that separating the two is increasingly becoming an artificial division that is not reflected in the characteristics of production processes. As an example, Marshall 1994 points to the difficulty that applies to existing terms coined to describe structural change in the economy, such as post-industrialism, de-industrialisation, etc.

Pousette and Lindberg 1989 show, on the basis of Swedish data, that manufacturing is becoming increasingly services dependent. Nonetheless, there was no significant correlation between service intensity and profitability in manufacturing. One of the main conclusions is that we are witnessing a shift away from standardised factory production to services production in manufacturing; in terms of cost structures, at least half of manufacturing activities are services. All observations are, however, hampered by the poor quality of available data. Pousette 1989 elaborates this issue, by comparing the manufacturing industry's demand for internal and external services in eight European countries. The differences in manufacturing demand between countries proved difficult to explain. It was, however, possible to test whether technological sophistication (with R&D expenditures as a proxy), firm size, organisation of firms or labour market flexibility influence the demand for services. It turned out that no strong correlation was found. Apparently, the author concludes, other, non-economical factors have to be called upon in order to explain the demand for services.

Abernathy-Utterback cycle as the process of regeneration of technology growth in a mature industry that has exhausted the technological opportunities in the present regime.

[39] Ed Steinmueller, private communication

Technology is restructuring many manufacturing and services industries, (Guile 1988). Barriers between industries are disappearing and interdependencies are strong,

> "[s]ervices such as communications, finance, transportation, and health care are large, capital intensive industries responsible for commercial application of some of the most sophisticated technologies available." (Quinn 1988)

Equally, manufacturers become service producers. The content of services in the manufacturing industry is growing and technology dependent, see f.i. Quinn 1986, 1990, 1992. Concrete policy issues (Quinn and Doorley 1988) arising from this may be summarised as follows:

i) macroeconomic and tax policies focused on improved capital formation rates, lower cost of capital, and lengthened investment time horizons,

ii) increased and better-targeted national investments in both hard and soft infrastructures supporting services,

iii) restructured regulatory practices to improve the efficiency and innovativeness of the services sector,

iv) a focus on employment and human resources development policies more appropriate to the mobility and intellectual skills required for a services-dominated society,

v) stronger recognition and exploitation of services-manufacturing interface potentials in international trade measurements and in trade negotiations.

Information technologies applied in services change the structure of domestic and global competition in both goods and services industries (Quinn 1992). The manufacturing and service sector are interdependent, with the share of services in manufacturing growing.

Through the impact of new generic technologies in services,

* new economies of scale appear, leading to larger institutions, often with a decentralised structure,
* new economies of scope, created by new technologies, have often unintended and beneficial second order effects,
* increased complexity can often be handled more efficiently with new technologies.

II Innovation in services

Introduction

At an aggregated level service sectors have traditionally been regarded as innovation laggards, complementary to the viewpoint that these sectors are productivity laggards. We conclude from our discussion that such viewpoints can be traced back to the debate in classical economics theory on delineating economic systems, a debate that became obsolete with the development of the neo-classical framework in economics. As long as service products are transacted through economic interactions between providers/suppliers and users - through the interaction between the utility satisfising or cost minimising behaviour of customers and the profit maximising behaviour of suppliers - service production, provision and consumption are definitely aspects of the economic system.

Being productivity laggards, it follows that service sectors may represent a loss to societal welfare, through the substitution of 'progressive' activities in the Baumol sense, i.e. welfare expanding activities, with 'stagnant' activities. If the transition from progressive to stagnant activities is associated with changes in the composition of final demand - as in an Engelian transition of an increased share of services in final consumption, due to differing income elasticities - we need to distinguish two classes of service activities, those that are intermediate inputs into other production processes and services provided for final consumption.

Principally this is the only distinction that is relevant from an economic dynamics perspective, arising from the distinction between the two opposing forces active in the system, profit maximising producers/suppliers and utility maximising consumers. Furthermore this is a universal distinction; in the sense that it does not distinguish between material or immaterial production, between productive and unproductive production/consumption etc. Though there are no qualitative differences within the stylised framework of neo-classical economics between the functioning of consumer and intermediate markets, it is reasonable to think in terms of these two categories.

Hence, if product properties were solely economic *in origin* we would neither expect any differences in the way service and (material) goods markets function, nor as regards their effect on generating productivity change. There are thus no *a priori* reasons for differences in levels of productivity change across the services/manufacturing barrier. If service and material goods markets function differently, the sources of these differences must be sought in their non-economic properties; properties that generate or modulate their economic behaviour. The origin of such differences must be sought in the product's specific characteristics; in its

physical and informational properties, the relation between these properties[40] and the product's relations with other products. Different economic properties of immaterial and material goods; between 'services' and 'products', must then be sought in the different economic attributes of physical and informational properties. This is not the place to develop this argument further, but the distinction will imply differences to

- the way 'products' and 'services' satisfy wants and the characteristics of these needs,
- their transaction properties, and hence market relations,
- users' and producers' mechanisms for benefit appropriation,
- production and consumption structures.

Directly or indirectly all these may create a non-vanishing differential in productivity change in the production of material goods and services. If the characterisation of service sectors as productivity laggards is correct, it raises a series of questions that are of direct relevance to public policy. The relevance is most direct in the case of services produced for consumer markets. It could imply a serious inefficiency in the employment of resources in the total production system, with a corresponding misallocation of these resources, leading to non-optimal economic welfare.

But this would also lead to dynamic inefficiencies in intermediate service markets. As the intermediate service markets we observe are external to the firms in the production chain, the service producer in the productivity stagnant activity would experience increasing relative prices of its products, reflecting the increasing productivity gap with the progressive sector of the economy. Hence we must expect that the service user as a cost minimizer would either reduce the amount of relative inputs from the service sector, through substituting the service inputs with other capital inputs to its production, or that (s)he would internalise the service function. Inside the firm, we expect the service user to reorganise production to minimise dependence on the service function, either by keeping its volume at a minimum, or by the expanded scope of reorganisation leading to relative productivity enhancing measures allowed by direct control over the service activity. As our observations differ from the predicaments of this arguments, there must be institutional barriers that prevent this process, supposing the assumption of these services as productivity laggards is correct. These barriers would directly imply dynamic inefficiency in this system. Thus a direct policy objective should be to redeploy productive resources, opposing this transition, to ensure optimal welfare.

If we insist that stagnancy or asymptotic stagnancy of service sectors and the structural transformation from manufacturing to services are fully led by Engelian demand changes, generated by increasing income, or changes in demand structures at constant income, the increasing price gap between manufacturing and services imply

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[40] Evidently both kinds of goods have both categories of properties; both physical and informational. We suggest however that when physical properties is dominant in some sense, we call it a 'material product', whereas when informational properties are dominant, it is classified as a service.

that either the demand for manufacturing products has reached its saturation point or that we are in the middle of a transformation where the overall, declining productivity growth will finally lead to a reconstitution of manufacturing sectors as demand will eventually be shifted back towards manufacturing.

The dynamism in structures and operations of service functions, and in their relations with other sectors of the economy, does not support the received opinion of these service functions as innovation laggards. On the contrary, 'common sense' based observation suggest at least that within the mixed bag of activities called services, there are highly innovative, as well as less innovative, sectors, and firms, just as in manufacturing industries. An indication of the scale of innovative activity in service sectors may be that when Acs and Audretsch reduced the US Small Business Administration innovation database (Acs and Audretsch 1988) to innovations occurring in manufacturing sectors, half the innovation universe was excluded; of about 8000 innovations introduced in 1982, roughly 4500 were retained. This implies that about 3500 innovations were non-manufacturing.[41]

Countless individual examples illustrate that there have been tremendous productivity increases in a wide variety of service sectors. In retail trade the development of super- and hypermarkets has rocketed productivity, in terms of both labour usage and capital requirements. Transport and distribution have been revolutionised by the container revolution, boosting productivity and restructuring the transport infrastructure. Telecommunication, even when restricted to telephony, in the 1990s is a universe apart from the situation in the 1950s, while the scope and scale of financial transactions have multiplied almost beyond reckoning. Medical services now allow for large scale standardised treatment of diseases and casualties that were leading edge treatments just a few decades, or even years, ago.[42] But even more so, in all these kinds of service industries, the development has been paralleled by proliferation and diversification that has completely altered the service landscape.

At an aggregate level, Hannah 1995 argues from a European perspective that productivity development in service sectors explains a significant part of the divergent development of several European countries and the US from the mid nineteenth century and onwards; the American miracle. In this period the US was 'catching up and forging ahead', while Britain, the original leader, was 'falling

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41 The innovations were recorded on the basis of references to the innovations in specific sections, listing innovations and new products, in technology, engineering and trade journals. More than 100 journals were examined, covering all four-digit SIC manufacturing industry. Two comments are warranted from this; (1) the coverage suggests a bias towards manufacturing industries, or those (engineering) parts of the service sectors that are most closely associated with the technological fields of the manufacturing industry, and (2) the innovations evidently include imitating innovations, creating the possibilities for additional biases.

42 These examples illustrate also the variety in mechanisms behind the changes in service industries; the 'pure' service innovation of the super- and hypermarkets, simple tangible innovations like the container, the contingent development within a 'telecommunication industry complex' (to paraphrase president Eisenhower's military-industrial complex), the adjustment of financial sectors to IT-based tools and infrastructures and the science-based development of health technology and practices and drugs.

behind' (these expressions refer to processes described in the 'catch(ing) up' literatures, see Abramowitz 1986). Hannah's argument is that while productivity development in manufacturing industries were important, they were important *everywhere*. That is, they do not explain the differential pattern across the Atlantic Ocean.

Hannah states that an explanation of the distinct pattern of US developments must be sought in the service sector. In particular, Britain matched living standards in the US towards the end of the nineteenth century because British service sectors were highly superior. According to Hannah, the reason for the US forge-ahead lay inthe development of the service industries, which in contrast to the strides in manufacturing competitive advantages, did not leak abroad due to low trade and multinational investment of service industries. Today US service industries have taken over the position that British services had at the beginning of the century. The US emerges as the productivity leader in several services, (cf. McKinsey 1992 and Baily 1993).

The outcome of this is that there is a definite need to identify processes in service sectors that are changing productivity characteristics through widening scopes of service provision. As these processes are what is included in the concept of innovation processes, this leads to the need to map and analyse innovative performance in service sectors. This is the theme we will turn to in the following three chapters. The first chapter will describe measurements of R&D activities and technology in services, before describing measurements of innovation in the next two chapters: chapter 5 examines empirical measurements of innovation activities and chapter 6 charts some attempts at developing innovation theories for services.

4 R&D, capital and trajectories

4.1 R&D in services

Traditionally, R&D surveys as defined by the OECD Frascati manual (OECD 1994) have focused on manufacturing industries. During the 1980s it was increasingly recognised in several countries that the frame of these surveys should be extended to include at least a subset of perceived R&D intensive service industries. Since 1985 the coverage of service sectors in R&D surveys has been increased in a number of countries, leading to a significant increase in the share of service sector R&D. But it must be noted that this trend is not uniform in all countries, both as to the sampling of surveyed service sectors, and to which service sectors are included; in fact no two digit NACE service industry is covered by all countries (OECD 1996d).

The following table shows the share of R&D in the service sectors of total Business Expenditures on R&D (BERD) in 1981 and 1991, supplemented by recently available figures for 1993, in OECD countries. As evidenced in the table, there has been a significant increase in the service share of BERD during this period in countries with a wide range of characteristics. In several countries service sectors account for more than 20%, or even 30%, of BERD; a share that, though still considerably below that of services' total share of GDP, is a large increase from the situation around 1980.

The last column in the table gives the assessment of the statistical authority in each country responsible for the R&D surveys of the coverage of service sectors. Even though the questionnaire used by OECD as a basis for this assessment considered sectoral coverage only, and not the sampling frames within each sector, there seems to be a fairly good correspondence between relatively high levels of service R&D and a satisfactory sectoral coverage.

We might add some comments to this distribution of services' R&D.

- The increased coverage in the NSF survey has given a level of service R&D in the US that is comparable to the Batelle estimate of 1986 (Alic 1994).

- Secondly, the shares in the table reflect the biases of the present coverage, with a primary emphasis on business (in the wide sense) and ICT services. Hence the shares should not be compared with the total service share of GDP, but to the share of the service sectors covered. This will more closely reflect the R&D intensity of these services and re-emphasises that they form an important part of the national R&D system.

Table 4.1 Share of BERD in service sectors. Percent. Source: OECD 1995a, OECD 1996d

Country	*1981*	*1991*	*1993*	*Satisfactory coverage*
Austria	6,1	4,0[1989]	-	-
Belgium	11,6	5,8	-	N
Denmark	18,8	28,5	32,5	Y
Finland	3,9	12,8	12,3	N
France	2,4	4,2	-	N
Germany	1,5	2,4	-	N
Greece	5,7	30,0	32,7	Y
Ireland	3,6	3,4	11,4	Y
Italy	7,1	9,0	10,7	Y
the Netherlands	6,0	6,7	9,8	N
Portugal	9,7[1982]	27,2[1990]	-	-
Spain	7,9	16,4	15,9	Y
Sweden	5,6	3,7	5,1	N
UK	-	16,1	18,2	Y
Iceland	0,0	18,3	-	-
Norway[*]	38,8	41,8	20,8	N
US	4,2[1982]	24,8[1992]	-	-
Canada	9,2	26,8	30,6	Y
Australia	17,1	33,8	31,7	Y
New Zealand	-	35,2	31,3	Y
Japan	3,1	2,1	2,3	N

* 1981 and 1991 numbers include technological contract R&D institutions that mainly serve the business sector, having a substantial public funding. Being included in the OECD business enterprise sector, these institutions accounted for about 39% of BERD in 1981 and nearly 28% in 1991. These institutions are excluded from the 1993 number.

- Thirdly the fact that Frascati based surveys have primarily been oriented towards manufacturing sectors, with an initial prime focus on technology and natural sciences[43], has two consequences relevant for R&D surveys of service sectors in a period of extending the surveys.

  - The concepts used are strongly reminiscent of their manufacturing heritage, using terms and methods of communications that may be difficult to relate to in some service sectors.

[43] The restriction of R&D business sector surveys to engineering and natural sciences is still valid for Canada and the Netherlands.

* In addition the act of responding to these questionnaires involves the need to interpret and transform the terms and concepts used into a framework that is applicable to the enterprise of the respondent. Through participating in a series of surveys these interpretations and transformations are refined at the level of the individual respondent or enterprise. It seems safe to assume that the amount of this tacit and experience based knowledge is weaker in the services covered in the recent R&D surveys, both as a consequence of the lesser accumulated number of responses and of the greater need for translations of concepts.

- Fourthly as we shall see below there is reason to believe that the internal organisation of R&D activities in service enterprises is less extensive, less formalised, than is usual in many manufacturing industries. A more diffuse concept of R&D, in addition to indistinguishable borders between 'search' and problem solving activities and production in highly customised production, may bias R&D measurements considerably.

- Finally the numbers reflect national characteristics, both of the service sectors themselves and of the sectoral definitions being used in national classifications. In the table this is reflected in the numbers reported for Norway, where the numbers include R&D performed by a large sector of formally autonomous R&D institutions doing contract research for business enterprises, with a high level of public attention and funding: a set of 'semi public' R&D institutions.

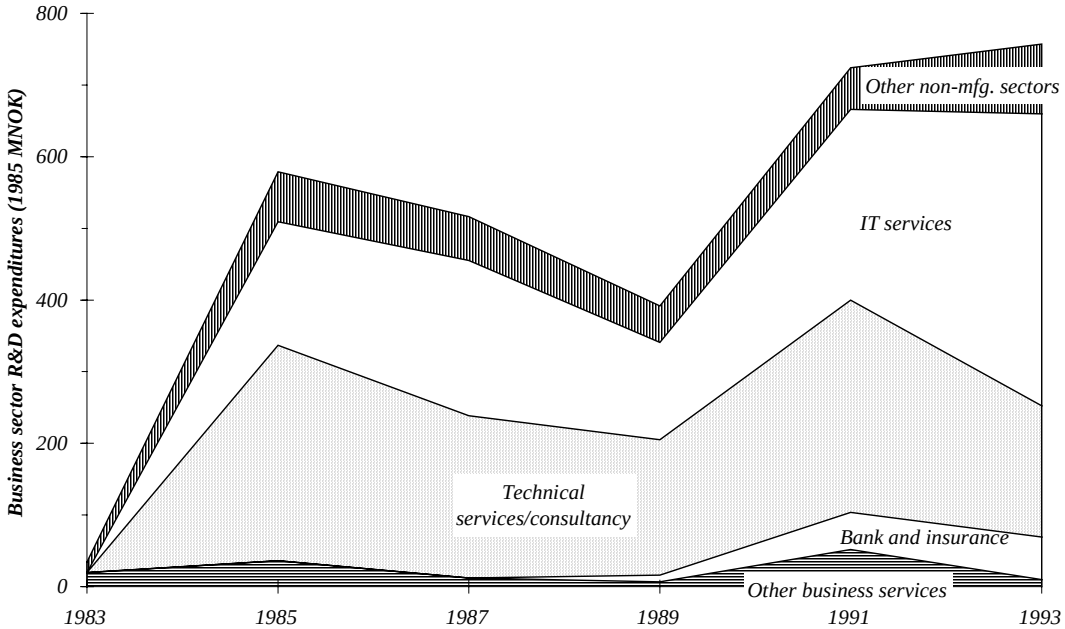

Figure 4.1 The structure of service R&D in Norway 1983-1993

The development of the distribution of Norwegian R&D in the ISIC rev. 2 sectors 81, 82 and 83 is shown in figure 4.1 for the period 1983 - 1993, with the R&D sector excluded. As can be seen the measurements of R&D in these services started in 1985. The sample frame has been revised several times over the years particularly during the first few years. Furthermore, responsibility for performing the business sector survey was shifted between 1989 and 1991 from the national technological research council NTNF to Statistics Norway. Services R&D in Norway includes in addition a

relatively minor part related to marine transportation and to trade services. As can be seen a substantial share is related to technical or technology related services, which has also been the main locus of these surveys.

Figure 4.2 R&D performed by business enterprises in non-goods sectors is shifting towards non-R&D service enterprises.

Though there is a series of methodological questions when analysing these numbers, it seems safe to conclude that R&D in service sectors makes up a significant share of total R&D activities in the business sectors in a wide range of industrialised countries. It is difficult to say, however, whether this is an effect solely of the increased coverage of the service sectors, or if it also reflects a real increase in service sector R&D. In particular it is an open question whether the slowing down of growth rates, even to the extent of a reduction of the reported R&D investment of business enterprise R&D in several countries at the beginning of the present decade is also valid for sectors outside the sample frame of these surveys.

One immediate assumption might be that the growth in business sector R&D in several countries during the 1980s was equally valid for the service sectors. Some support might be found f.i. in the Norwegian data. The cyclical dependency of R&D expenditures in services may be reinforced by a larger substitution of intramural R&D with contracted R&D in downturns. An indication that this might be at least a partial explanation is the results of the retrospective revision of the 1991/92 R&D surveys in the UK and US which "attenuated the major declines originally reported for 1991/92" (OECD 1995a). Both these revisions substantially increased the service R&D shares. Attenuation of the 1990-92 decline in business expenditures on R&D (BERD) is also evident in Canadian data, where a nominal zero growth (+0,4% p.a.) of non-service BERD is drowned by an average annual growth of service BERD of 6,6% (Gault 1995).

These revisions, in the US affecting both service and manufacturing R&D, illustrate the possibility of seriously underestimating services' R&D. For 1992 the US revision (see NSF 1994, the revision is described in NSF 1995) more than tripled the level of R&D expenditures in non-manufacturing industries.[44] Such uncertainty is translated directly into a parallel uncertainty in the estimates of R&D intensities. Nevertheless, the following table based on US data, table 4.2, shows two things: that R&D intensive service sectors may have R&D intensities (as a share of sales) comparable to R&D intensive manufacturing sectors, and that the huge variations in R&D intensities in services is not significantly different from the similar variations in manufacturing.

Apart from R&D and testing services (US SIC 873) the most R&D intensive industries are included in the category of engineering and computer-related services (exc. communication related services), with R&D/net sales higher than even aircraft and missiles (11,8%) and pharmaceuticals (10,7%). Secondly, a comparison with the overall numbers of QSEs (Qualified Scientists and Engineers), see NSF 1992, shows that there seems to be close correspondence between a measure of 'science and engineering' intensity, as QSEs' share of total employment and the R&D intensities in table 4.2. Communication, computer related and engineering and R&D and testing services accounts for close to 3/4 of nonmanufacturing R&D expenditures. Even though this is not surprising, it may point towards an effect of a 'science' bias of the R&D statistics underlying the numbers in the table. Such an effect would primarily be expected to affect other services, with a low R&D intensity in the table, particularly financial services and business services that are not covered by the identified categories.

Similarly, Canadian R&D data, with an estimated services share of BERD of more than 30% in 1993, allots 58% of services BERD to communication, computer, engineering and other scientific services (Gault 1995). In the Norwegian R&D data the dominance of computer and engineering services is almost total; these industries account for more than 80% of services BERD, even when the technology dominated Norwegian research institute sector is excluded (NFR 1995). To an uncertain, but probably considerable, extent this is a reflection of a sample bias in the R&D surveys. The extension during the 1980s of national R&D surveys towards service sectors has primarily focused on business services. In addition we would expect that the concepts and definitions used in these Frascati manual based surveys are easier to relate to for these services.

If R&D activities in one or more service sectors are organised more diffusely than similar activities in manufacturing sectors this is particularly relevant. The Frascati manual expressly excludes R&D efforts that are dispersed in the organisation, "it is recommended that [R&D surveys] should include all units where at least one full time equivalent is worked on R&D per year" (OECD 1994). There are several indications that R&D in service firms are less formally organised than activities in manufacturing firms. This may be an effect of conscious (re-)organisation of innovative activities in the organisation, with innovative activities being performed

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[44] Note that Pollak 1991 uses the 'pre-revision' numbers for services R&D.

integrated with ongoing productive activities, either permanently or on a project basis, or that innovative activities are performed on an ad hoc basis. Based on data from the French tax credit scheme, more than half the service firms with less than 100 employees have informal R&D activities (Gadrey & al 1993). Even for large firms an informal R&D organisation in service sectors is more frequent than in other sectors.

Table 4.2 R&D intensities in US industries 1992. R&D-performing companies. Source: NSF 1992

	R&D funds (M$)	*Domestic net sales (M$)*	*R&D Scientists and engineers ('000)*	*Domestic employ-ment ('000)*	*R&D/Net sales*	*RSE/-employ-ment*
Food products	1411	263406	9,8	1023	0,5 %	1,0 %
Chemicals	16711	279595	85,6	1150	6,0 %	7,4 %
Machinery	15135	193697	99,3	1347	7,8 %	7,4 %
Electrical equipment	13546	236605	91,9	1382	5,7 %	6,6 %
Transportation	26484	380434	141,1	1902	7,0 %	7,4 %
Manufacturing	91211	2175876	576,8	11327	4,2 %	5,1 %
Communication services	na	188215	34	1002	na	3,4 %
Electric, gas and sanitary	na	172088	1,7	556	na	0,3 %
Computer-related services, engi-neering and architectural services	6663	48996	52,9	367	13,6 %	14,4 %
Hospitals, medical and dental labs	615	17591	4,4	294	3,5 %	1,5 %
R&D and testing services	9667	14068	52,4	164	68,7 %	32,0 %
Other nonmanu-facturing	7429	446619	57,1	2922	1,7 %	2,0 %
Nonmanu-facturing	30103	887577	202,5	5305	3,4 %	3,8 %

This picture is confirmed by two Dutch innovation surveys of service sectors, performed respectively in 1988 and in 1993 (Kleinknecht, Reijnen and Verweij 1990,

Brouwer and Kleinknecht 1994 and 1995). These innovation surveys (cf. chapter 5) use a wider concept of R&D than the Frascati manual, and should be able to catch some aspects of R&D activities, particularly as to informal R&D, that fall outside the ordinary R&D surveys.

While the share of informal R&D (defined as the share of R&D performed outside an R&D department of total R&D effort) in services was more than 35% in service firms in the Dutch 1992 survey, while the manufacturing average was less than 10% (cf. table 4.3). For some service sectors like transport and communication and other commercial services (including business services like engineering and management consultancies) more than half R&D effort is performed outside a central R&D department. For the category including business services this is so inspite of a relatively more frequent use of a central department with responsibility for R&D activities.

Two other modes of R&D organisation are shown in the table; contracting R&D to other organisations and R&D collaborations. Comparing these structures the figures - apart from the *aparte* category of public utilities - suggest a greater propensity to diffuse, informal R&D, often taken as a signal of supplier dominated innovation strategies, little use of a formal R&D organisation, marginal share of R&D being placed on external R&D contracts, but a high frequency of R&D collaborations. It is noteworthy that more than half the firms in a wide range of service sectors report R&D collaborations, maybe suggesting a strong ‘network’ reliance of R&D activities amongst these firms.

It is also worth noting that more than half the firms in the category other commercial services report R&D collaboration, in spite of being relatively the most R&D department intensive service industry. This is in contrast to the situation seen in manufacturing, where the most R&D intensive industries often use R&D collaborations for limited, deliberate purposes, as a complement to internal R&D activities, and hence with a relatively lower share of R&D collaborating firms. The differences in aggregation and levels between sectors in table 4.3, does not allow this kind of analysis, which would require considering R&D collaboration reported by R&D performing firms.

This suggests that R&D in several service sectors plays a role that differs from similar activities in manufacturing firms, (but maybe more in degree than in kind), which shows up in the different organisational structures of these activities. Sundbo 1992 also shows that a process of increased ‘informality’ of service innovative activity is evident. This is a process that also finds its parallel in high tech manufacturing industries. Nevertheless, the table based on Dutch data also suggests that levels of R&D activities in service sectors are lower than in many manufacturing sectors. This raises wider questions of how these service firms develop and change, as well as pointing to the problems of measuring activities that are widely dispersed and performed integrated with ongoing ‘ordinary’ activities.

More important than problems of measuring R&D in services is the question of whether R&D in any reasonable way reflects innovative behaviour in service sectors. Even within manufacturing industries it is well established that there is significant variation in the overall relation between R&D and other innovation activities. This is

a general conclusion that may be drawn both on the basis of sectoral patterns in the use of innovations (Pavitt 1984) and on the basis of innovation activity surveys such as the European Community Innovation Survey (CIS).

Table 4.3 Character of R&D activities in service sectors and selected manufacturing sectors. Source: Brouwer and Kleinknecht 1995

	R&D department*	***Outcontracted R&D****	***R&D collaboration****	***Informal R&D, share of total*****
Food and beverages	22,8	13,3	45	32,3
Paper, prntng and publish.	4,3	2,6	60	28,8
Chemicals	30,9	17,1	54	7,3
Manufacturing	**15,8**	**9,7**	**43**	**9,2**
Public utility	21,6	23,9	97	9,5
Construction	2,7	1,8	45	41,5
Trade	3,7	2,3	45	20,2
Hotels and restaurants	1,1	1,3	n.a.	28,5
Transport and communication	0,6	1,1	66	51,3
Banks and insurance	1,6	1,7	51	37,6
Other commercial	9,0	5,2	53	51,3
*Other non-commercial****	7,6	6,2	52	6,5
Services**	**4,1**	**2,7**	**50**	**36,2**

* Share of national total number of firms.
** Share of total R&D activities performed outside R&D department.
*** Includes R&D labs.
**** Includes utilities and construction.

In the next chapter we will extend the discussion of R&D to innovation activities. However, first, in the following two sections, we will discuss the role played by technology in services and innovation processes.

4.2 Capital stocks in services

The view that service sectors are labour intensive activities with low capital intensity, and capital stocks dominated by plant investments, is incorrect. As we saw in the introductory chapters, some service sectors are at least as capital intensive as manufacturing industries, with a shift in financial services away from a dominance of plant (as buildings and fixtures) investments. In reality the capital intensity of services has never been low. In terms of capital-labour ratios - a measure of the capital requirements needed behind each work place - service sectors were at least as capital intensive as manufacturing a long time before WW II. This can be seenin table 4.4, which gives data for the US in 1935. The dominant position of the transport, communication and public utilities sector is primarily caused by the infrastructures related to public utilities, but we note that even the category of 'consumers' services' is comparable to manufacturing and agriculture.

Table 4.4 Capital-labour ratio in US 1935. 1935 US$/worker. Source: Clark 1957

Sector	***Capital-labour ratio***
Manufacturing	3 700
Transport, communication, utilities	11 900
Mining	8 700
Agriculture	3 900
Commerce	2 000
Consumers' services	3 700

Tables like this do not reflect the different compositions of capital stocks in comparing sectors; We need togive a structural break down of capital stocks to allow for a more meaningful comparison. Roughly, we may consider capital stocks as consisting of three main parts; intermediates, raw materials and other inventories; buildings and other fixtures; as well as capital machinery and equipment. Though distinctions like these are not well-defined, available statistics can give an indication of structural change in the composition of capitals. Using OECD data, figure 4.2 shows the development of the share of capital stocks in machinery and equipment in the same sectors that are described in figures 2.1 and 2.2 for the G7 countries where these data are available. In financial services the ratio has increased rapidly, having doubled over the two decades. Both transport and communication and financial services have nearly half the capital stock tied up in machinery and equipment. Quite clearly this reflects a significant increase in investment in information and communication technologies. This is in agreement with Harris and Katz 1991; IT capital investments represented approximately 52% of total capital outlays in 1985 by insurance companies, outnumbered only by the telecom business with 54%.

A similar shift in manufacturing industries is also noted in figure 4.2 where the share is about 60% towards the end of the 1980s. If we assume that the IT-intensity of this shift is less than in the two service sectors, the figure probably underestimates the shift to a larger extent for the service sectors. This is partly due to the rapid fall of IT price indices like the price of one megabyte storage capacity or megaflops; even though the assessment of the reality of these indices is difficult. But partly, and

maybe most important, a real underestimation for both grand sectors is due to the intangible effects of these IT investments.

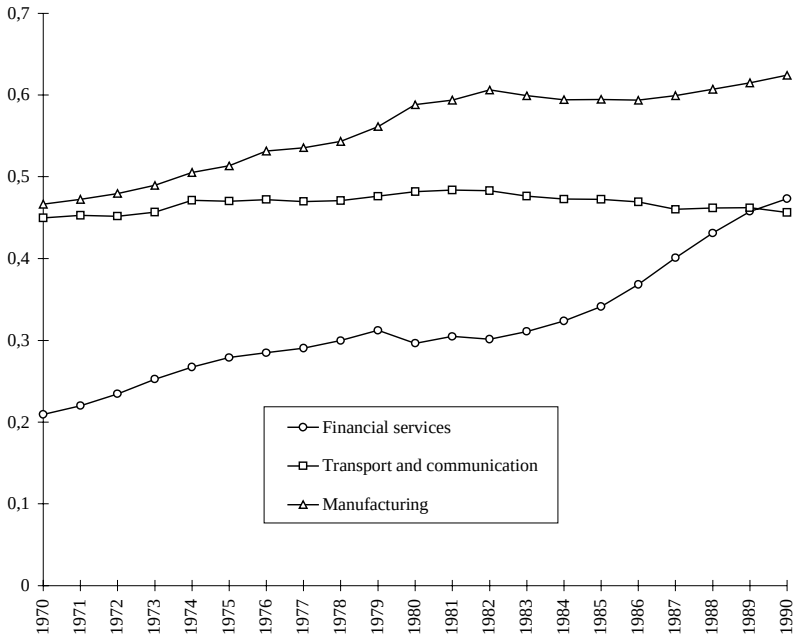

Figure 4.3 Share of machinery and equipment in total capital stock for G7-countries. Source: OECD ISDB

Firstly, the figures measure tangible investments. There are wide perceived differences in the potential of different technologies to improve efficiency and firm performance, potentialities that are usually related to differences in the complementary investments and 'accommodation' costs necessary to implement the technologies. Information technologies are regarded as the generic technology with the greatest potential for improving efficiency and changing firm structures; it is in a sense perceived as the 'most generic' technology of generic technologies; it is the most pervasive of all new technologies.

Total IT spending in the OECD area is estimated at nearly 360 billion US$ for 1994 (OECD 1996c). Of this, less than half is hardware related, the remaining 54% being accounted for by packaged software (19%) and IT services (35%). Secondly, major IT investments are related to two types of learning effects that will delay achievement of potential benefits of the investments (see f.i. dos Santos and Peffer 1995), a first-order learning-by-doing, which may involve restructuring organisational structure and routines, and a second-order learning where the IT structure feeds back into a transformation of the organisational goals. As these learning processes may take a considerable amount of time, the 'cost' involved may be quite considerable, as well as enabling a innovative restructuring of the business.

Kutscher and Mark 1983 were among the first to consider the validity if the hypothesis of low capital intensities in services. On the basis of publicly available statistics they classified 145 economic activities by capital labour ratios, showing that

the lowest 30% of sectors did not include service activities. Nearly half of the thirty most capital intensive sectors were service activities or public utilities, with a dominance of transport services and public utilities. Based on US data, Roach 1988 shows that the share of capital spending accounted for by service industries has been more than 50%, and increasing, since the mid 1960s, a pattern that is reflected in the overall average growth rates of the capital stock in US industries, table 4.5.

Table 4.5 Capital stock, average annual growth*. Percent. Source: Roach 1988

	1950s	1960s	1970s	1980s
Manufacturing	3,5	4,7	3,3	1,7
Other non-services	5,7	2,2	3,1	2,8
Communication	6,4	6,7	6,0	4,6
Finance	5,8	8,7	7,4	7,8
Insurance	7,2	6,2	3,4	6,3
Real estate	6,2	6,2	3,1	4,0
Business services	10,3	11,4	6,8	7,9
Legal services	5,0	2,8	1,4	6,2
Trade	3,9	6,8	5,1	5,6
Other services	2,4	2,7	2,8	1,5
Services total	3,6	4,5	3,8	3,6

* Figures based on constant 1982 dollars. Other non-services include mining and construction. Other services include transportation and public utilities and personal and social services, but exclude governmental services.

The industries with the highest growth rates are the information based or providing services, where we would expect the most dominant IT strain. In contrast to the manufacturing industries, the annual growth rate of capital stock in producer services continued during the second half of the 1980s to lie above the mean level of the thirty preceding years (Roach 1991a).

Information technologies contributed significantly to capital formation in the 1980s both in services and in manufacturing (Roach 1991a). While the growth of capital stock in manufacturing was almost exclusively caused by increased investments in information technologies, other forms of capital still grew in the services, with an annual growth rate between 1983 and 1988 of about 2-3%. This growth rate was outnumbered however by investments in information technologies, with a growth in IT related capital stocks approaching 15% annually. A growth rate of this order would double the IT related capital stock in just 4-5 years. The changing structure of the capital base of *all* services is shown in figure 4.3, illustrating the increased role of IT and the lessening of the dominance of plant investments.

In these figures IT includes office, computing and accounting machinery, communication equipment, instruments and photocopiers and related equipment.

Basic industrial groups together engines and other machinery, general transmission, distribution and industrial apparatus, as well as other metal products.

As we saw the IT intensity of capital spending was substantial in financial and telecom services. Figure 4.3 hides this heterogeneity of the different service sectors, but combining it with the table above we begin to get a more consistent picture. This picture is confirmed by a survey of computer use in the US, performed by the US Department of Commerce in 1993 (see OECD 1996c). While 46% of the work force used computers at work in 1993, this use was strongly correlated with educational attainment; while just 1/3 of high school graduates used computers, the same applied to nearly 70% of those with four or more years of college. The industries with the highest levels of use was FIRE services (finance, insurance and real estate; 75%), followed by public administration (70%) and professional and related services (51%).

In 1988 the most IT intensive industries, with IT intensity measured as the share of IT in total capital stock, were education, telephone and telegraph, motion pictures, finance and insurance, health, wholesale trade and business services, in that order (Roach 1991a), all ranging above 30%. By comparison, the most IT-intensive manufacturing industries are electrical and non-electrical machinery, with IT representing 23% and 20% of capital stocks respectively. Some of the sectors mentioned, such as education, though fast growing, are marginal in terms of the share if total ‘IT-capital’. But the list includes also the largest IT investors, such as telecom and financial services. Overall IT-intensity has grown substantially over the last decades in both services and manufacturing. While the IT shares were about 5% and 2% in the mid-1960s in the two sectors, intensity had quadrupled in services to almost 20%, while it had quintupled for manufacturing to more than 10%, by 1988.

We may conclude that the major share of IT capital is located in a few services, primarily the communication and financial sectors, accounting for close to 50% of IT capital stock. Though this share has declined, emphasising the pervasiveness of IT, the growth of this stock of capitals has been tremendous, it has quadrupled from the early 1970s to 1985. For the financial sector and business services it increased tenfold in the same period. This points towards Barras’ argument of regarding these two sectors as the ‘vanguard’ sectors of a service revolution (Barras 1990), a point to which we shall return later.

In order to compare these structures to European data, we will not be able to consider sumilar data for capital stocks, but rather have to use industrial capital flows. Figure 4.5 describes the structure of capital investment in service sectors in Germany and France between 1972/1978 and 1990. Figure 4.5 is based on inter-industrial capital flows described by the OECD Input Output tables (OECD 1995c). We have associated broad classes of investment objects with originating industry. We have identified transport and distribution with flows of capital goods from transport equipment industries and trade and transport sectors, into service sectors. ‘Industrial products’ is identified as flows emanating from production of metal products and non-electrical machinery, whereas ‘electrical machinery/IT’ includes electrical machinery, professional goods, office and computer equipment.

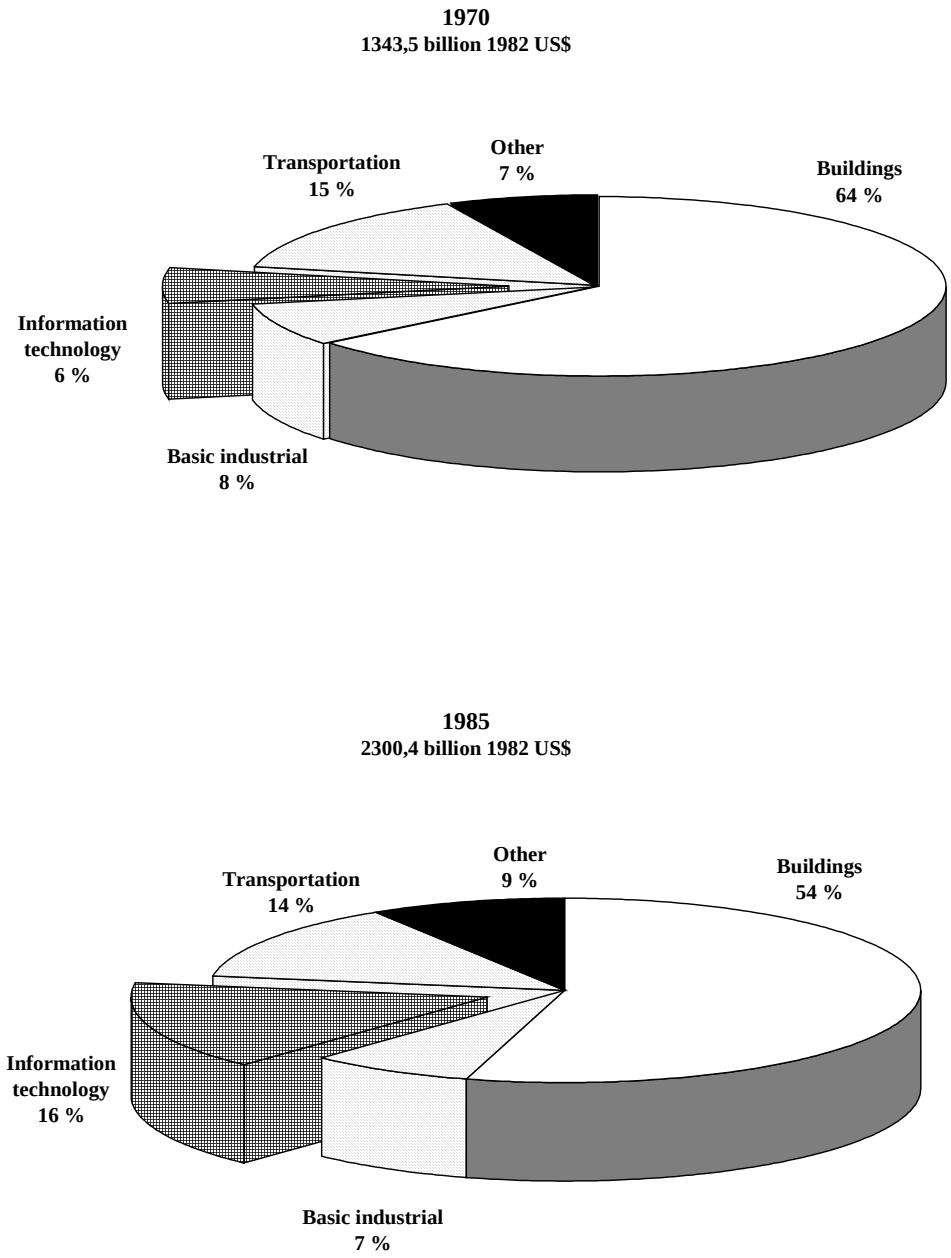

Figure 4.4 The structure of the capital stock in US services 1970 and 1985 in constant 1982 US$. Source: Roach 1988

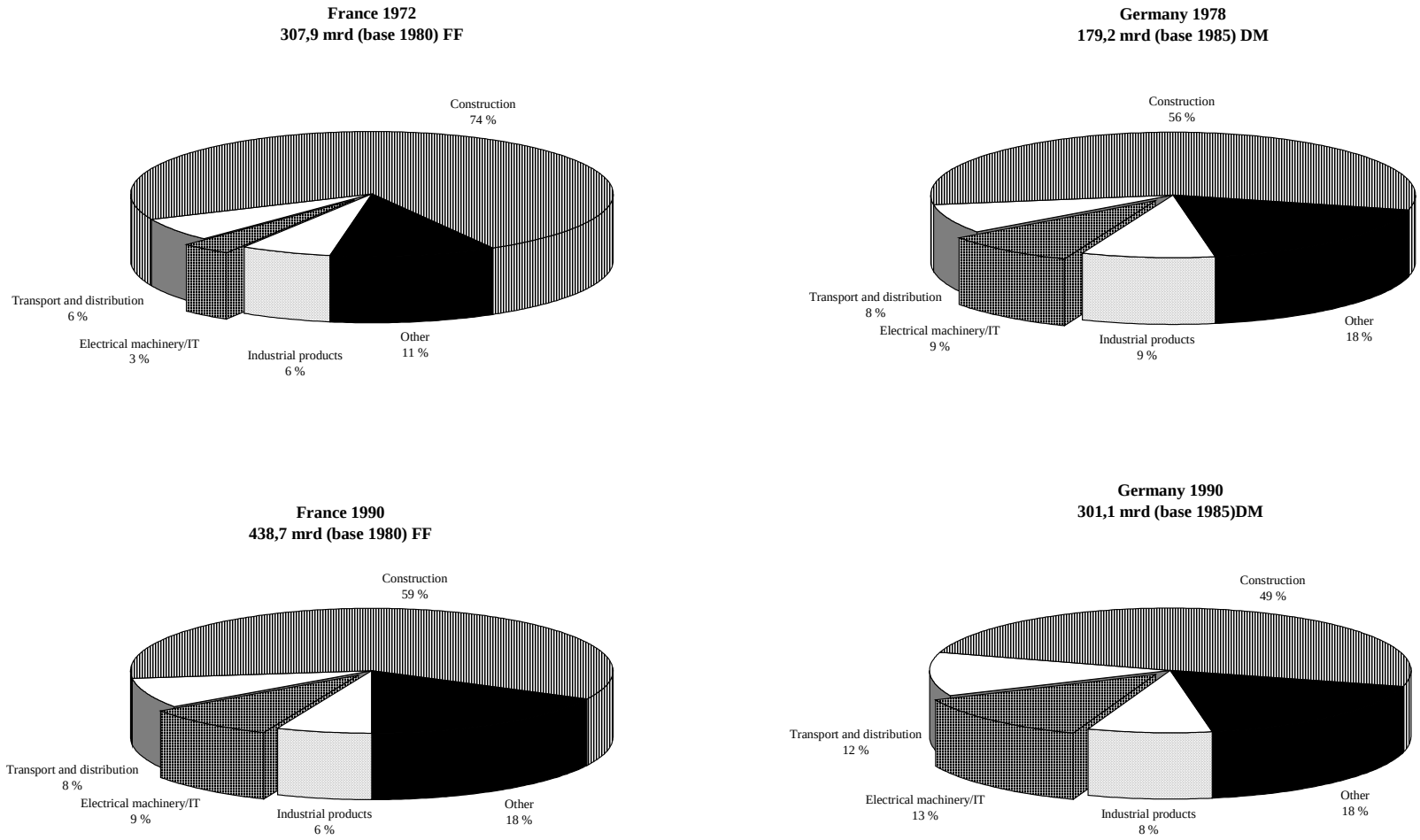

Figure 4.5 Capital formation (Gross fixed capital formation) in services, France and Germany. Source: OECD 1995c

Since the turnover rate of investments in buildings is significantly longer than rates for other capital structures, we would expect to see the share of buildings being reduced. Since the capital flow matrices of the US do not include the construction sector, we cannot control for this. Comparing figure 4.5, France and Germany, with figure 4.4, US, two features are immediately striking. Firstly, IT investments seem to have a larger share in US service sector capital stocks than in German and French ones. Partly this may, however, be a technical artefact, considering the different constitution and construction method of the two measures. But the wider definition of 'IT' that is used in figure 4.5, together with the relatively larger depreciation rates that are used for capital IT goods (making the IT share of investments larger than the IT share of capital stocks), imply that there is a real effect. Secondly we note the difference in the size of investments in buildings and fixtures between Germany and France.

Though it is a long leap from these developments to conclusions about developments of productivities (as in manufacturing industries, where the present concept of IT excludes IT-based industrial technology, such as robots and CNC-equipment), Roach 1991a shows that there is a strong differential trend between US manufacturing and service industries in the composition of white-collar labour force. While the development during the 1980s in manufacturing sees significant reduction in information support personnel as compared to executives and (other) professionals, there are considerable disparities between service industries. IT-intensive industries like transport and communication and finance and insurance show development comparable to manufacturing industries, while other services have slower trends. According to Roach, these trends "may well be at the heart of the service sector's productivity dilemma".

Comparing the preceding sections with the present, a pattern seems to emerge of varied, but possibly distinct, modes of knowledge and technology acquisition amongst the service sectors. Whereas some services are characterised by increased R&D efforts in a sense that is more or less captured by Frascati-like concepts, others appear as more capital driven. Yet others seem to use more ad hoc and diffuse strategies. This overall variety is something that is well known from manufacturing and supports the view that a grouping of all service sectors as supplier dominated misrepresents the dynamic processes shaping and creating modern services. If anything we would expect to be able to see significant innovative behaviour in service sectors, a question we turn to in the last section of this chapter. We will do that with an attempt todelineate technology based innovation trajectories in services. In the next section we will outline some aspects of the development of human resources in service sectors.

4.3 Human resources in services

The labour intensity of services directly implies that human resources, the consitution and qualities of the labour force, play an important role. The cost of labour is a substantial cost element. Economising with these resources may have significant impacts on the cost structure, and hence on the relative prices of services. This is particularly evident in several consultancy-like services, where labour costs may be used as a basis for mark up pricing behaviour. But it is evident that it also applies to

all other labour intensive activities. We will later see how wage level spill-over from other sectors may afflict services with 'cost disease' (cf. chapter 6), as it may incessantly increase the price of buying services, relative to buying goods produced with less labour-intensive production.

An essential part of this equation, is productivity of labour inputs. Increasing productivity is an important alternative to restraining costs, as reducing wage rates to compensate for increasing relative price gaps. Labour productivities, as measured in public statistics, increase also in services as it does in other sectors. However, as is well known by now, the problems of measuring productivity and quality increases in services are ubiquitous (see f.i. Griliches 1992), both for pure measurability and for conceptual reasons. But even though a quantitative level of productivities, and their growth rates, may be difficult to determine, it is no doubt that there is a positive growth rate in the long run.

The - by now familiar - measure of productivity growth that is not explainable in terms of more extensive use of 'ordinary' inputs, is growth of total factor productivity (TFP). The detailed specifications of TFP may differ, but the measure is essentially a residual of the total output growth rate; the difference between the growth of output and a weighted sum of the relative growth of input factors[45]. The existence of a non-vanishing long run TFP is usually interpreted as a measure of productivity increases enabled by technical change, reorganisation of production processes, of changes in human capital etc. As such it is a very crude measure; it tells what we cannot measure with present measuring tools.

In traditional growth accounting framework, the analysis is based on output and input measures for the whole economy. Jorgenson 1995 states that "the assumptions that underlie [this] aggregate model of production fail to hold" in recent periods. This raises the need for more detailed sectoral analysis. Figure 4.6, where the data are taken from the OECD Inter-Sectoral Database, describes the total growth of total factor productivity between 1970 and 1992 (or the latest available year) in four broad service sectors, wholesale and retail trade and hotels and restaurants (ISIC sectors 6), transport and communications (ISIC 7), finance, insurance, real estate and business services (FIRB, ISIC 8) and community, social and personal services corresponding to ISIC 9 except government services. These sectors are compared to utilities and a manufacturing total, with the service sectors ordered to emphasise the inter-sectoral trend.

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[45] It is also known as the 'Solow residual', cf. Solow 1957. The measure should be interpreted with caution; being a residual it is difficult to relate to individual sources of growth. Abramowitz 1989 stresses this and characterises it as a 'measure of our ignorance' in explaining economic growth.

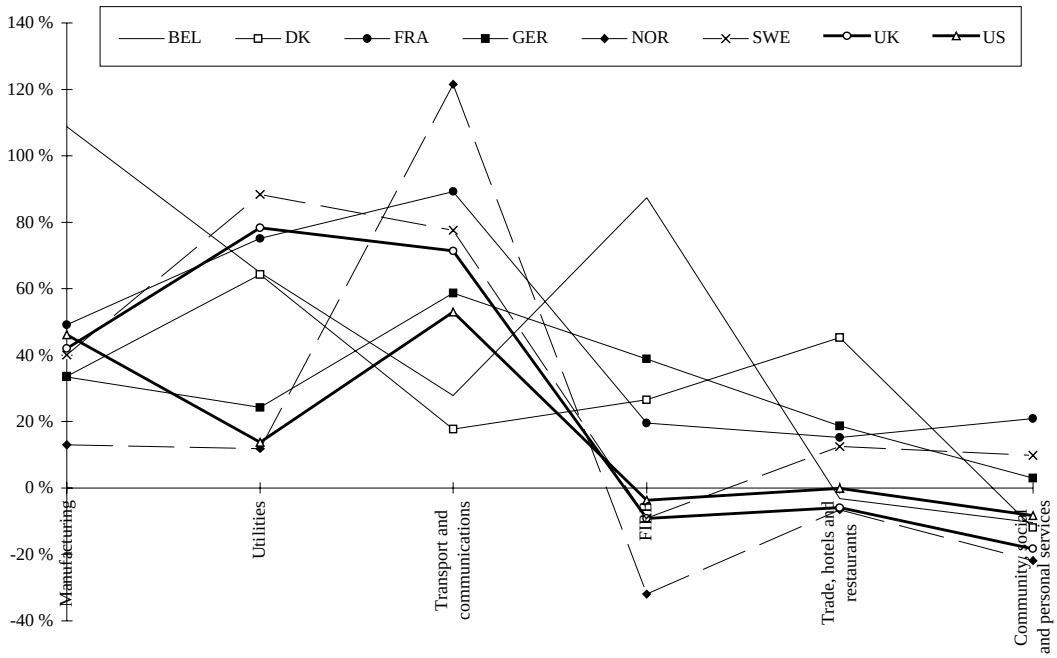

Figure 4.6 Sectoral growth of total factor productivity 1970-1992. Source: OECD ISDB
FIRB = Finance and insurance, real estate and business services, except for Belgium, Germany and the UK, where it is given for financial services alone.
Trade, hotels and restaurants cover only the trade sectors in Denmark.

TFP growth is large for transport and communications, also in comparison to manufacturing and approaching zero on the average for community services. Secondly the spread of national values seems to be decreasing as TFP growth diminishes.

These figures are, however, somewhat misleading, as they do not properly take into account the consequences of sectoral description. A sectoral approach must also take into account the effect of changes in the volume of intermediate inputs. Jorgenson 1995 summarises an analysis of sources of growth at sectoral level in the US in the period 1948-1979. The study covers 51 industries, covering agricultural, mining, manufacturing and service sectors, 13 of these being service sectors outside state and federal service and the household sector. Essentially amending the equation described above by a term measuring the use of intermediate inputs at sectoral level, the result is that “intermediate, capital and labour inputs is the predominant source of output growth” in nearly all industrial sectors. Thus the result seems to lead to a confirmation of the ‘capital investment’ based policies, as opposed to ‘residual enhancing’ human capital policies. Surprisingly enough this also seems to be the case for instance for non-electrical machinery and instruments. It would seem that the majority of the 51 industries emerge as ‘supplier dominated’, as regards sources for output growth. But there are some - perhaps surprising - exceptions to this.

Firstly, in fifteen industries, of which four are service industries, TFP growth is negative, representing “a decline in overall efficiency of production”. The service sectors are public urban transport, transportation services, broadcasting and ‘other services’, including business services. Jorgenson suggests changing relative prices as

an explanation of at least some of these declines, especially as it relates to energy prices.

Table 4.6 Growth in sectoral output and its sources US 1948 - 1979. Average annual rate of growth in percent. Source: Jorgenson 1995

	Output	*Inter-mediate inputs*	*Capital inputs*	*Labour inputs*	*Rate of pro-ductivity growth*
Food	2,81	1,34	0,18	-0,02	1,31
Chemicals	5,91	3,29	0,91	0,50	1,21
Non-electrical machinery	4,17	2,40	0,62	0,80	0,36
Electrical machinery	5,80	2,62	0,58	1,02	1,58
Railroads and railway express systems	0,53	-0,46	0,19	-1,08	1,87
Trucking services and warehousing	4,88	2,22	0,72	0,78	1,16
Air transportation	9,57	4,21	1,03	1,53	2,81
Communications	6,88	0,77	2,34	0,87	2,90
Wholesale trade	4,25	0,64	0,90	1,27	1,45
Retail trade	2,93	0,91	0,43	0,56	1,03
FIRE	4,93	3,41	0,31	0,76	0,44
Other services, exc. private households	3,77	2,86	0,64	0,78	-0,52

Secondly, maybe more surprisingly, less than ten industries have total factor productivity as a major source of growth. This includes agriculture, electrical machinery (including the IT sector), but also railroads and railway express systems, air transportation, telecom, water supply and sanitary services, together with wholesale and retail trade. Data for some of these industries are given in table 4.6. Five sectors are service industries. Of these at least some, such as air transportation, are sectors where real output is measured independently of input, in contrast to substantial parts of the residual other services.

It is a drawback of these data that the residual class of other services is not further broken down, in order to allow identification of sub-classes such as types of business and social services. On the other hand these are also sectors where we would quickly encounter limitations of measurement. But here we will suggest that these data indicate, contrary to common beliefs, that the majority of sectors that have been most amenable to 'Solow residual' enhancing measures, lie in the service sector. Referring back to figures 1.1 and 1.2, these sectors include the sectors with fast employment growth, and probably also sectors that have been recepients of the outcome of the general 'upskilling' of the labour force.

Mapping human resources in a consistent way is difficult. We are usually limited to using proxies that capture at least some elements of these resources, but have to forego a complete analysis (some issues related to this issue, such as immaterial investment on the firm level, were considered in several papers at the recent OECD

indicators conference in Paris, May 1996). We will here focus on one immediate proxy, the formal educational background of the workforce, though limited, that promises to catch at least some dimensions of this issue. We will restrict attention to tertiary education. Extension to include other types of education, and the structural relations between different types of education, will have to wait for future studies.

Comparison of educational attainment between countries is difficult, due to structural differences in education systems. International standards such as the UNESCO International Standard Classification of EDucation (ISCED) often prove difficult to apply to continental European style post-secondary educational systems. Figure 4.7 indicates that overall there have been shifts in the period before 1990 in overall educational attainment. The figure describes the distribution of educational attainment in terms of three levels, up to and including secondary education, a class of 'university degree', the share of the population with at least one university degree completed, and a residual category 'other post-secondary'.

The expansion of secondary and post-secondary education leads to a situation where around 20-50% of the young age classes may enter post-secondary education. This has two immediate consequences. Firstly, it may change supply to relevant labour markets. Secondly, upgrading general educational levels will probably contribute to changes in demand patterns. There are however important cross-national variations in these patterns, shaped by differences in structures and cultures around and in national education systems.

The expansion of secondary and post-secondary education in these countries over the last decades has led to rapid upgrading of the average educational attainment of the population. In the US the share of college graduates in the labour force increased from 14,6% in 1973 to 22,9% in 1987 (Appelbaum and Albin 1990). The share of the total Norwegian work force with education at ISCED level 6 or higher was about 15% in 1994.

However, these shares vary greatly along two dimensions. There are variations between industries, and between fields of education. Table 4.7 gives the distribution of (natural, social and life) scientist and engineers (QSEs) in the US in 1992 according to broad industrial categories. The stock of QSEs in the US economy is shared about equally between the 'goods' and 'non-goods' sectors (NSF 1993). But while the growth in manufacturing employment of QSEs abated and even declined in the late 1980s/early 1990s, non-manufacturing employment increased by 35% between 1986 and 1992.

The distribution of QSEs can be compared to the distribution of the wider stock of college graduates; nearly half of the number of college graduates are employed in 'information-knowledge services' (including professional services, communications, FIRB services and public administration, Appelbaum and Albin 1990), while about 22% are employed in 'goods' sectors. We draw two conclusions from this. Firstly, there are significant intra-group variations, between different service and manufacturing industries, in the employment of higher educated personell. The distribution seems to be related to some concept of information or knowledge intensity. Secondly, there are strong differences in the distribution of this personell both across a 'goods'/non-goods' division and between 'public' and 'private' sectors

along a field dimension and possibly according to level. QSEs have a greater propensity to be employed in ‘private’ and ‘goods’-based sectors.

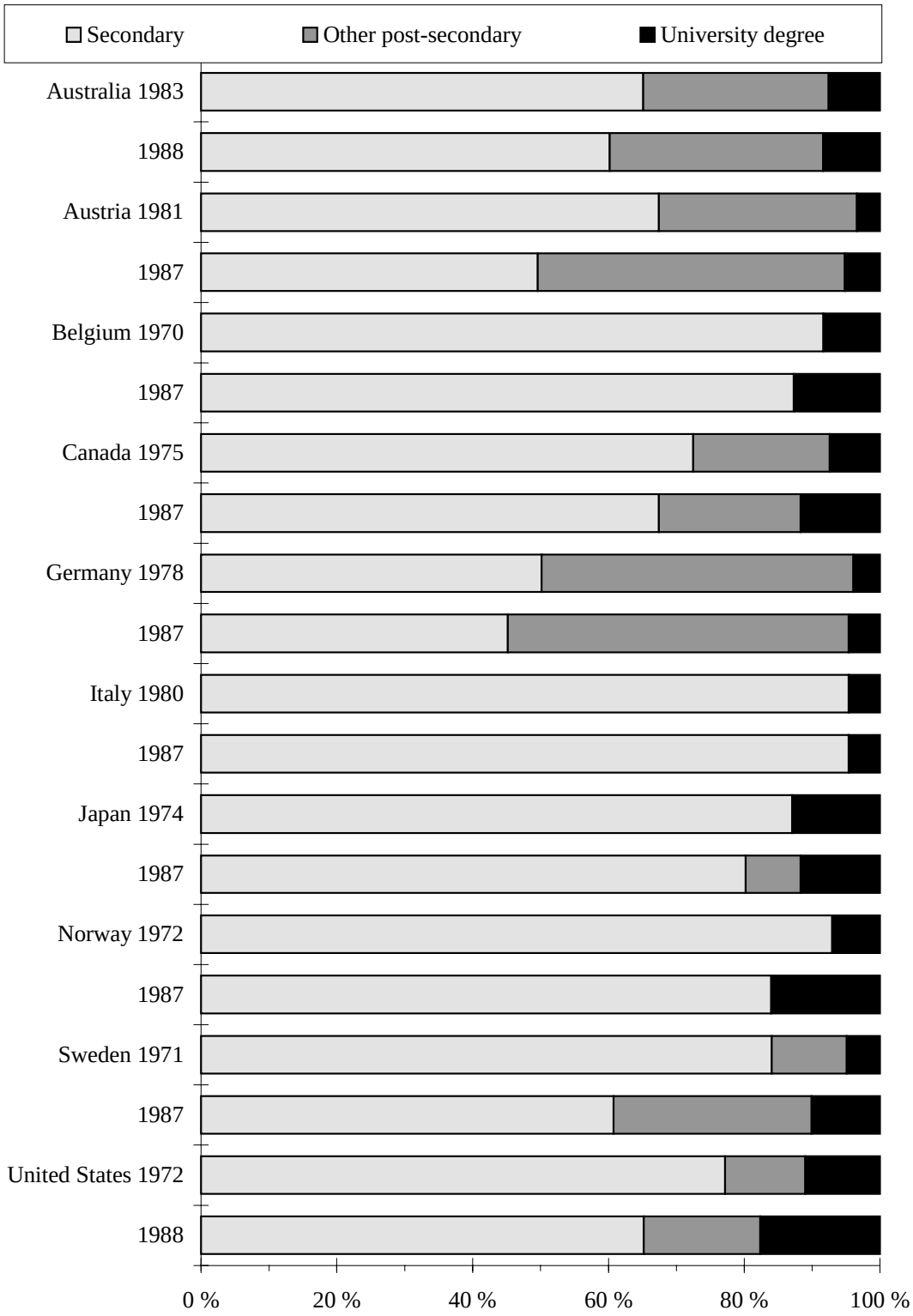

Figure 4.7 Educational attainment in the ‘working age’ population in OECD countries. Source: OECD 1992b

Table 4.7 Distribution of scientists and engineers in US 1992 by industry. Source: Based on NSF 1993

	QSE
Manufacturing	49,3 %
Other goods sector	3,7 %
Communications, Transport & Utilities	5,7 %
Trade	5,4 %
Financial services	6,3 %
Engineering services	9,3 %
Computer services	8,5 %
Other services	14,4 %

The gap between shares at QSE-level and at college graduate level is substantial, but reflects more the composition of offered education at these levels, than level as a direct criterion in employment decisions.

Comparing the distribution in table 4.7 with the sectoral shares of employment gives a measure of the share of these categories of personell in the sectorial work forces. Whereas US manufacturing accounts for about 20% of total employment outside government services, their share of total QSE employment is at least double this figure. At the other end the trade sectors account for more than 25% of total employment and about 5% of QSE employment. Even though this makes overall manufacturing the most - and trade the least - QSE-intensive aggregate sector, this hides wide inter-industrial variations, as well as substantial variations according to firm size. R&D-intensive and scale-intensive industries dominate the QSE-statistics, just as R&D-intensive business services, primarily related to technology, dominate the QSE employment in the service sectors (see f.i. NSF 1990). Within trade sectors there is, unsurprisingly, a higher intensity of QSE/HEP employment in wholesale than in retail trade, and especially in wholesale sectors related to intermediate producer or capital goods.

The Swedish 1993 stock of academically trained natural scientists and engineers (NSEs, QSEs but restricted to natural sciences and technology) reflects the same pattern (Stenberg, Gustafsson and Marklund 1995). 40% of the overall stock of NSEs in the Swedish business sector are employed in manufacturing industries, a concentration that is probably less pronounced than the US numbers. 36% are employed in technical service firms, such as computer and technical consultancies, machinery wholesale, R&D firms and industrial research associations. The remaing 24% are employed in other non-manufacturing sectors. Also in Sweden the growth in manufacturing employment stagnated in the early 1990s, while the category of ‘technical service firms’ increased its employment of NSEs by 40% between 1987 and 1993.

Table 4.8 Higher educated personell in the Norwegian work force 1994 by scientific field. Percent of graduates (ISCED level 6 or above) within work force and field*

	Natural Sciences	*Techno-logy*	*Business Administration /Economics*	*Social Sciences*	*Other fields*
Manufacturing	11,5	18,8	10,1	3,6	2,0
Other goods sectors	9,8	16,5	5,1	2,2	1,1
Market services	26,9	38,7	52,3	21,7	7,7
Public services exc. educ., health and social services	18,8	16,1	17,3	30,6	8,6
Education, health and social services	33,0	9,9	15,2	41,9	80,6
Private sector	48,2	74,1	67,5	27,5	10,8
Public sector	51,8	25,9	32,5	72,5	89,2
N =	19 060	33 848	23 436	20 120	149 306

	HEP All fields	*Total employment*
Manufacturing	6,0	16,4
Other goods sectors	4,3	9,7
Market services	18,9	38,0
Public services exc. educ., health and social services	13,0	8,4
Education, health and social services	57,8	27,4
Private sector	29,2	64,2
Public sector	70,8	35,8
N =	245 770	1 689 931

- The table gives the distribution of graduates at ISCED level 6 or higher according to broad industrial category. The last column describes the overall 1994 employment distribution in the Norwegian economy.

The structure of Norwegian employment of higher educated personell is shown in table 4.8. These data, taken from our own analysis of Norwegian employment data from Statistics Norway[46], show a somewhat different pattern. The general feature that shows up in any analysis of HEP employment, is of course the dominance of the education system and health and social services; nearly 60% of the Norwegian HEP employment is in these sectors. The dominant position of the public sector in these

[46] For a description and analysis of the data, see Hauknes and Nås 1996.

activities also explains the private/public distribution of employment; while nearly 3 out of 4 employees with a background from social sciences outside economics and business administration at ISCED level 6 or above are employed in the public sector, 3 out of 4 with a technological background are employed in the private sector.

The concentration in manufacturing industries is substantially less pronounced than in Sweden; It is naturally enough primarily technology, business administration and natural sciences that dominate the private arena. The dominance of market services, here corresponding to ISIC rev. 2 categories 6 - 8, is evident; to compare with the Swedish distribution cited above, 52% of business enterprise sector NSEs are employed in market service firms, while manufacturing accounts for 25%.

Table 4.9 Higher educated share of employment in market service industries, Norway 1994. Percent.

	Nat.Sci. Technology	*Economics Bus.Adm. Soc.Sci.*	*Other HEP*
Manufacturing	3,1	1,2	1,1
Wholesale trade	3,3	2,6	1,6
Retail trade	0,4	0,5	1,0
Transport and communications	1,8	1,3	1,1
Financial services	1,6	9,2	1,7
Business services	13,5	7,3	2,7
Other services	0,7	1,0	3,0

The share of ISCED 6+ personell with a background from social sciences is higher than in manufacturing in several service industries (cf. table 4.9.). The most intensive users of these categories are financial and business services, business services including consultancies and accounting. Business services, through its inclusion of technical and engineering consultancies, is the most intensive user of similar personell with technology or natural sciences as background.

This distribution may be compared to the German distribution of personell according to qualifications (cf. table 4.10). Even though the numbers are not directly comparable, due to differences in educational systems and patterns, the broad similarities in the pattern are clear. It is interesting to note the location of different service sectors in terms of ‘graduate intensities’ and TFP growth. High TFP growth seems to be linked both to both high and low ‘graduate intensity’. Similarly, barring drowning of business services in the residual category, a high density of scientists and engineers may even come with a negative TFP growth.

There are two possible linkages between these variables. First it seems reasonable to expect some level effect; the share of graduates being related to TFP levels; that is growth rates are correlated. A positive rate of change of graduate intensities would then translate into a positive TFP growth. On the other hand, assuming that educational level is a reasonable proxy for a scope for individual experience-based learning, as through a better interpretative ability of experience the higher the level, we would also expect a positive relation between the stock of employees at any

particular level and TFP growth rate. As we do not as yet have comparable time series available, we cannot test these hypotheses.

Table 4.10 Higher educated share of employment in market service industries, Germany. Percent. Source: Licht &al 1996

	Natural sciences, graduates of University and Fachhochschule	*Social sciences graduates of University and Fachhochschule*	*College graduates, Fachschule*
Wholesale trade	6	4	13
Retail trade	3	4	11
Transport and communications	2	3	9
Bank and insurance	4	12	13
Other financial services	6	12	15
Software	33	9	20
Technical consultancy, R&D-firms	40	7	12
Other business services	10	11	13

However, these linkages are not necessarily direct. Considering changes in the share of employment of higher educated personell, we run the danger of confusing a demand effect with a supply effect. The unprecedented growth of the education sector during the last decades is not demand driven. There is ample scope for the possibility that part of the ‘upskilling’ of both services and other economic sectors is a supply driven substitution effect, where higher educated personell substitute older ‘vintages’ of personell with a lower level. Part of what is observed may then simply be an ‘inflationary’ wave of substitution, that eventually may culminate in squeezing un- or low-skilled labour out of the work force (this is recognised as part of the ‘2/3 society’ argument).

However, barring the challenges such a process would pose, to what extent the new ‘upskilled’ personell can redefine working conditions and play out potentialities, depends not only - maybe not even primarily - on indivdual characteristics. The organisational framework is decisive for this, and especially so in the present context where the focus is on the economic actor, the organisation itself.

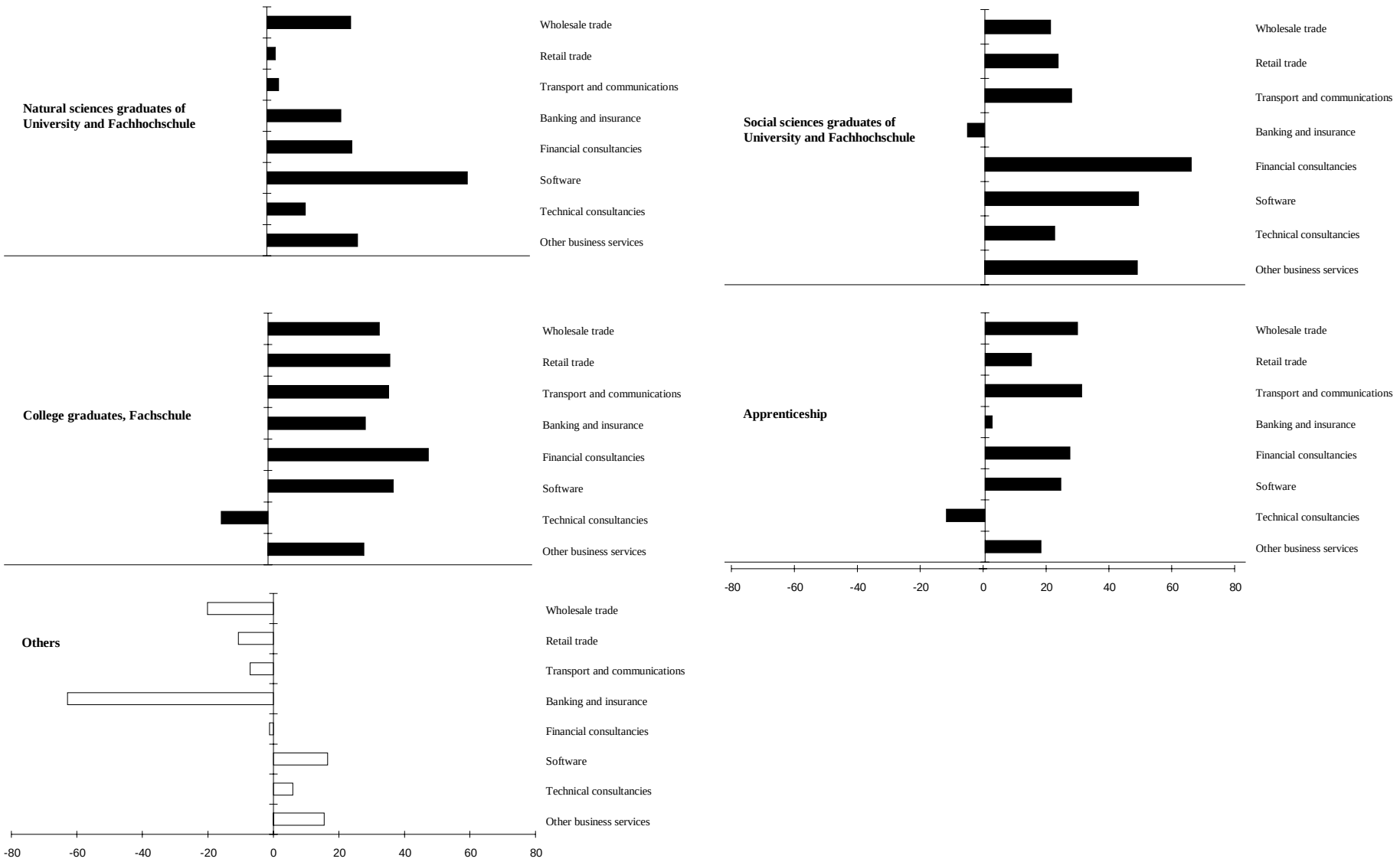

Figure 4.8 Prospects for employment growth in German service sectors. Source: Link &al 1996

The relation between individual and organisational processes, such as learning, is far from clear. To our mind one of the most exciting developments over the last few years is the increased and many-faceted attention given to questions relating to organisational development, from organisation scientist, sociologists and economists. Some recent references are noted in the bibliography. Some issues from the perspective of 'economic soicology' are noted in Ingham's recent survey article (Ingham 1996). A more extensive presentation by both economists and sociologists is the edited volume Smelser and Swedberg 1994. Perrow 1986 discusses the development of theories of organisations, and includes a insightful description of March, Simon and bounded rationality. Cohen & al 1995 provides an explorative discussion of relevant issues.

Does this mean that the individual level can be neglected? Probably not, even in the presence of strong contingencies between the two levels, individual or sub-group characteristics may play a decisive role in the shaping of the organisation. To claim this would be to commit the fallacy of over-socialisation in conseptualising human behaviour, cf. the discussion in Granovetter 1985.

If there are relations like the one we suggested between formal educational background on an individual level and organisational development[47], we are led to expect that adaptive firms in general have a more pronounced profile in terms of educational background. More explicitly, innovative firms should show a higher share of the work force with background from post-secondary education than non-innovators.[48] This is confirmed in the German service innovation survey, Licht &al 1996, where innovating firms have in general a higher share of of personell with post-secondary and university-level education.[49] There is a clear positive correlation with size; the share of innovating firms increases with size. The share of innovators amongst SMEs - less than 250 employees - is in fact larger for services than for

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47 This is a statement that the informal 'on-the-job'-training and organisational routine development is not completely independent of the former background the employee brings with her to the organisation.

48 Given the aggregate distribution of the work force in any country across education levels, the outcome could be indistinguishable from an argument stressing *variety* of educational background, contingent on the existing knowledge bases of the firm, as the essential characteristic.

49 The confirmation is however somewhat weakened by the fact the university level graduates in engineering and natural sciences are more frequent in the new *Bundesländer* than in the old ones, while the relation is opposite in the lower echelons of educational level. While this share is 15% in the old *Bundesländer*, it is just 6% in the western part of Germany, cf. Licht &al 1996, table 7.3.

The share of innovating firms in new *Bundesländer* is indeed higher than in the Western part, cf. figure 3.6 in Licht &al 1996, a fact that may be explainable in terms of a catching up effect of the new with the old *Bundesländer*. It is noteworthy that this is opposite to the relation for manufacturing firms, see Felder &al 1995. However, while the manufacturing shares are weighted results to measure national totals, service shares are sample shares.

manufacturing. But as this compares unweighted with weighted shares, it is difficult to determine if this is a real difference or a sample bias.

Figure 4.8 gives the respondents' assessment of the prospects for employment growth over a three year period (1995-1997) in German service industries in five qualification classes. The firms were asked to assess whether they expected an employment rise or a reduction for their firm over this period in five categories of personell, on a five point scale. Figure 4.8 is expressed as the difference between the share of total number of employees in the industry/qualification group that work in firms that expect a rise and the same share with firms that expect a decline, calculated within each qualification category and service industry. This construction implies that the index is expressed as 'share of labour force'. An extreme value, towards ± 100%, implies that a substantial majority of the relevant labour force works in firms that expect increase/decline. Small values signify that the expectations are fairly symmetrically distributed around expectations of a constant work force.

For the qualifications groups the share of employees in firms that expect constant employment falls from 66% of the NSE group to 48% for the apprenticed and residual categories. Roughly half expect to experience no change of employment on firm level within their co-group.

The overall expectations indicate a fairly clear distribution along the qualification parameter; larger shares of QSEs work in firms where employment of QSEs is expected to rise. A similar result arises for college level educated personell (*Fachschuleabsolventen*), while the employment of apprenticed workers (*Berufsabsolventen*) and the the residual category is closer to zero. For the former there is a weak expectation of growth, while for the latter there is an expectation of decrease.

Table 4.11 Industrial employment shares (1992 of total service sector employment) and qualification structure in German service industries. Source: Employment shares; C. Hipp/FhG ISI, private communication. Qualifications; Licht &al 1996

	Employment
Wholesale	9,2
Retail	17,6
Hotels, restaurants	4,4
Transport	7,3
Financial services	9,2
Real estate, leasing	1,9
Business services	6,6

Qualifications	
NSEs	8
Other QSEs	6
College graduates	12
Apprenticed	55
Other	18

To make an assessment of the aggregate employment prospects this must be compared to two sets of figures, the cross-industrial employment distribution and the distribution of qualification categories across industries. Indicatively these numbers are given in table 4.11.

On the basis of these data we are led to conclude that the process of 'upskilling' is expected to be continued, but we cannot draw any conclusions as to the size of this effect, and to whether this will continue the increase in concentration ratios of QSEs in services.

4.4 Innovation trajectories in services

4.4.1 The scope of innovation characteristics

As shown in figure 4.9 below, based on the Norwegian CIS data, R&D intensity at industry level in manufacturing performs badly as an explanator of innovative performance, measured as share of sales of products new to the firm, i.e. of technological product innovations as defined by the Oslo manual. As indicated it is associated with an R^2 of 0%; the variance on the industry level in the figure is left unexplained by this R&D intensity measure.

The conclusion we might draw from this diagram is that there is no uniform relation between R&D activity and innovative performance at cross-industrial level; there are large inter-industrial variations in the role played by R&D, in the qualities of technological opportunities present in the individual industries and in the competitive factors determining the level of R&D. This of course points to the need for widening the scope of analyses of industrial development far beyond the simple measures of R&D activity.

If this is the case for manufacturing industries, there are no reasons to expect that the heterogeneities of the relation between different innovation activities are less in services than in manufacturing. That raises the issue of extending measurements á la the OECD Innovation manual (the Oslo manual) to service sectors. A few attempts to do this have been made, as in the Dutch and German CIS surveys. In a later section we will describe some of the results of such surveys. But before doing that we will introduce a taxonomy of service activities that is closely related to attempts at describing characteristics of innovation processes in services.

This suggests a need to broaden the scope of inputs to and characteristics of change processes being considered in order to be able to characterise more fully the variety in innovation dynamics between different industrial activities. This includes a wide range of factors, such as technology characteristics, capital investments and industry AND market characteristics, and innovation processes and their interrelations, such as R&D, design, market research and 'tooling up'. External networks and frameworks may also be important. The Soete-Miozzo (Soete and Miozzo 1989) taxonomy is an extension of the taxonomy of sectoral patterns of technological trajectories in manufacturing industries that were introduced by Pavitt (Pavitt 1984).

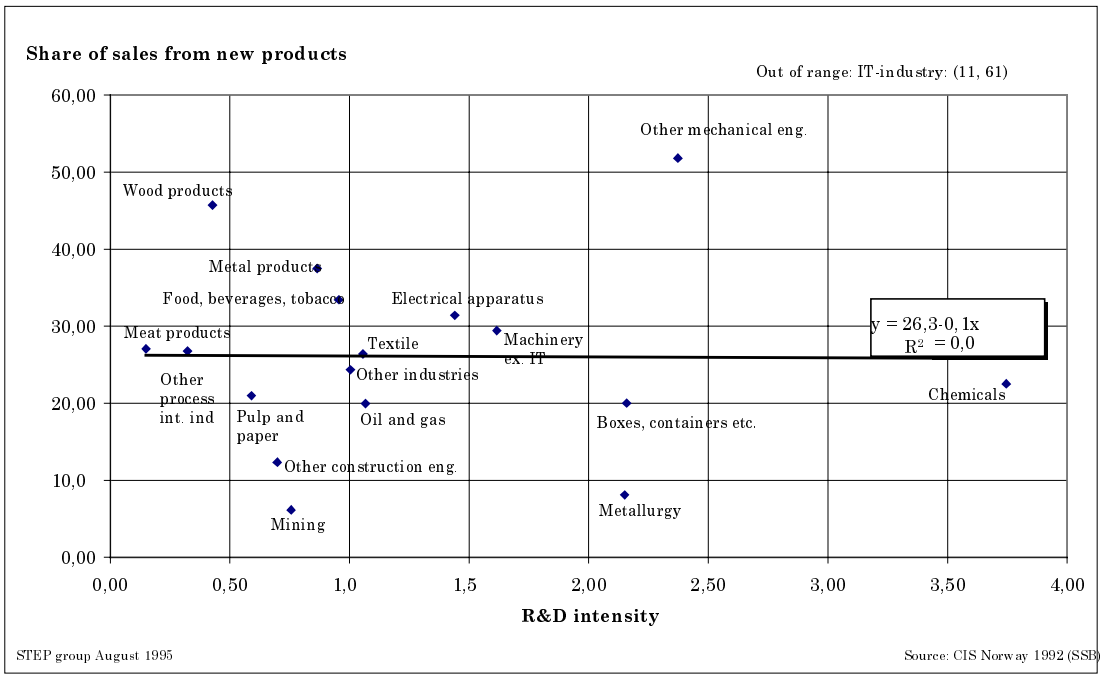

Figure 4.9 Share of sales from new products, by current R&D cost intensity. All industry by branches. N=321.*

* R&D intensity is the ratio between current R&D expenditures and total sales. Values are scaled to national totals. 'New products' are products, new to the firm, that have undergone large or small changes in specifications during 1990-92, but excluding minor aesthetic changes. The OLS regression line is calculated without the outlier IT-industry.

4.4.2 Sectoral classification of services

On the basis of the SPRU database on British innovations, technological change in broad industrial sectors were classified according to characteristics of sources of technology, of user requirements and appropriation strategies. Some characteristic features of the three sectoral trajectories (supplier dominated, production intensive and science based firms) proposed by Pavitt are described in table 4.12 below. The table is adapted from Pavitt 1984, with two columns (identified by italics) added, describing broad characteristics of firm-level capabilities and investment strategies. Production intensive trajectories are divided between the two main categories of scale-intensive trajectories and trajectories dominated by complementary specialised equipment suppliers to other industries. While Pavitt's taxonomy was intended to characterise the technological *trajectories* on firm-level, the categories are usually applied on some aggregated industry level, with the underlying assumption that f.i. a science-based industry is dominated, in some undetermined sense, by science-based firms. But this precludes interfirm and intersectoral disparities within any level of industry aggregation.

The characteristics of the individual trajectories imply that we must expect a certain correlation between innovation strategies and general strategies for investment in capital and intermediate goods. The table suggests a strong correspondence between the characteristics identified in the three last columns of investment and innovation strategies and demand characteristics and the innovation focus. Thus supplier dominated firms are expected to be largely oriented towards cost-cutting process

innovations with a concomitant capital-deepening and labour saving investment strategy. On the other hand, we expect specialised suppliers to be focused on performance enhancing product innovations and capital-widening, possibly labour enhancing, investment strategies.

Qualitatively we would expect the broad distributive pattern described in figure 4.10 to emerge when we compare innovation cost intensity and investment intensity of firms in the different trajectories. To the extent that these characteristics are relatively homogenous across firms in a specific industry, this distribution would also apply to an industrial classification. The characteristics of supplier dominated industries, with a large share of innovations emerging from external sectors and with the focus on capital-deepening, imply that these firms are located mainly in the NW part of the diagram. Similarly we expect science-based firms to be located in the SE part of the diagram, due to their high reliance on internal sources of technological knowledge. Scale-intensive industries would be located mainly in the upper two boxes, whereas specialised suppliers would lie towards the right. The qualitative picture is illustrated in the figure below.

The question then arises whether this pattern of technological change may be applied to service sectors as well. The first thing to notice is that the taxonomy is based on *technological* change and does not include change processes unrelated to technological dimensions at firm level. That is, the trajectories are *defined* by the role played by technological parameters in enhancing firm performance.

On the basis of the table it would seem that services in general would correspond to the category of supplier dominated trajectories. Service firms are - with a few notable exceptions - small, they are perceived to have a weak or at least a more diffuse organisation of innovative activities, relying heavily on adaptation to user needs. This viewpoint may be further reinforced by the dependence on significant IT investments in several service sectors, particularly in ICT, financial and business services in the NACE sense. Likewise appropriation of innovation benefits of services is often claimed to be oriented towards non-technical regimes of a similar character to the ones described for supplier dominated trajectories in the table below. Examples of this are ‘brand-naming’ strategies and the stronger role played by trust and quality considerations in user-producer service relations, f.i. with consultancies, and marketing strategies as in tourism.

We argue that this classification is not satisfactory. The reasons for this are several, and we will here briefly mention five such arguments. As will be seen, none of these arguments are exclusively valid for service activities, but may also be considered for manufacturing sectors. The first argument is simply that the ‘class’ of services is extremely heterogeneous, in terms of both different services’ functional characteristics and their technological and innovation characteristics. Thus we would also expect them to show widely varying development patterns, even in terms of adaptation of IT. The diversity in terms of user characteristics of IT in several services render it unlikely that they may be grouped together under a common heading. It seems unsatisfactory to treat transportation, banking and consultancy services on the same footing as technology users, given the widely disparate role played by technology in these services.

The second argument is that even focusing solely on use of information technology, the dominant role played by IT-intensive services, f.i. in the financial sectors, as customers of the IT capital goods sector, imply that these services are also the locus of significantly advanced users of IT equipment. This point is further reinforced by the overall sizeable presence of academic and other higher education staff in some of these services. That is, these services must be expected to be important determining factors in the shaping of IT producers perceptions of future major user potentials and requirements. A further strengthening of the process towards software being the main cost item of IT investments, would imply that a substantial part of future development of information technology will be located in sectors that are traditionally included in the service sectors.

Thirdly, the focus on *technological* innovation may miss features of productivity enhancement that are more prominent in some services than in manufacturing. Most directly it points to the possibility of a more autonomous role for organisational and structural changes, viz. organisational innovation, and architectural or modular innovations (in the sense of Henderson and Clark 1991) in service products. More specifically, some of the 'peculiarities' of services as f.i. a high degree of customisation combined with contemporaneousness of production and consumption, could imply totally different characteristics of markets and of change processes internal to the firm.

The fourth point is especially relevant to knowledge intensive activities and activities that are experiencing rapid changes in production and output characteristics. In industries where change in output mix or production technologies are relatively infrequent, innovations are often identifiable, even to the extent of being discrete events. The traditional approach of innovation studies of a basically static framework exposed to discrete, clearly identifiable events is viable, allowing an approach where knowledge generation and production may be treated as separate, though complementary categories.

Table 4.12 Sectoral classification of manufacturing technology trajectories. Adapted from Pavitt 1984

Trajectory	*Size of firms*	*Technology sources*	*Main focus of innovation*	*Technological capabilities*	*Appropriation*	*Investment strategy*	*Innovation strategy*	*User req.*
Supplier dominated	Small	Suppliers (capital equipment and materials); extension services, large customers	Process	*Weak engineering, weakly developed in-house R&D*	Non-technical (trademarks, marketing, aesthetic design)	*Capital-deepening*	Cost cutting	Price sensitivity
Scale-intensive	Large	Production engineering, suppliers, R&D	Process	*Skills to exploit economies of scale; process engineering*	Process secrecy and know how, technological lags, patents, cumulative learning	*Capital-deepening*	Cost cutting (product design)	Price sensitivity
Specialised suppliers	Small	Design and development; users	Product	*Complementary and specialised knowledge of equipment performance*	Design know-how, know-ledge of users, patents	*Capital-widening*	Product design	Perfor-mance sensitivity
Science based	Large	R&D; public science; production engineering	Mixed	*Technological and scientific knowledge; well-developed ties to R&D system*	R&D know-how, patents, process secrecy and know-how, cumulative learning	*Capital-widening/-Capital-deepening*	Mixed	Mixed

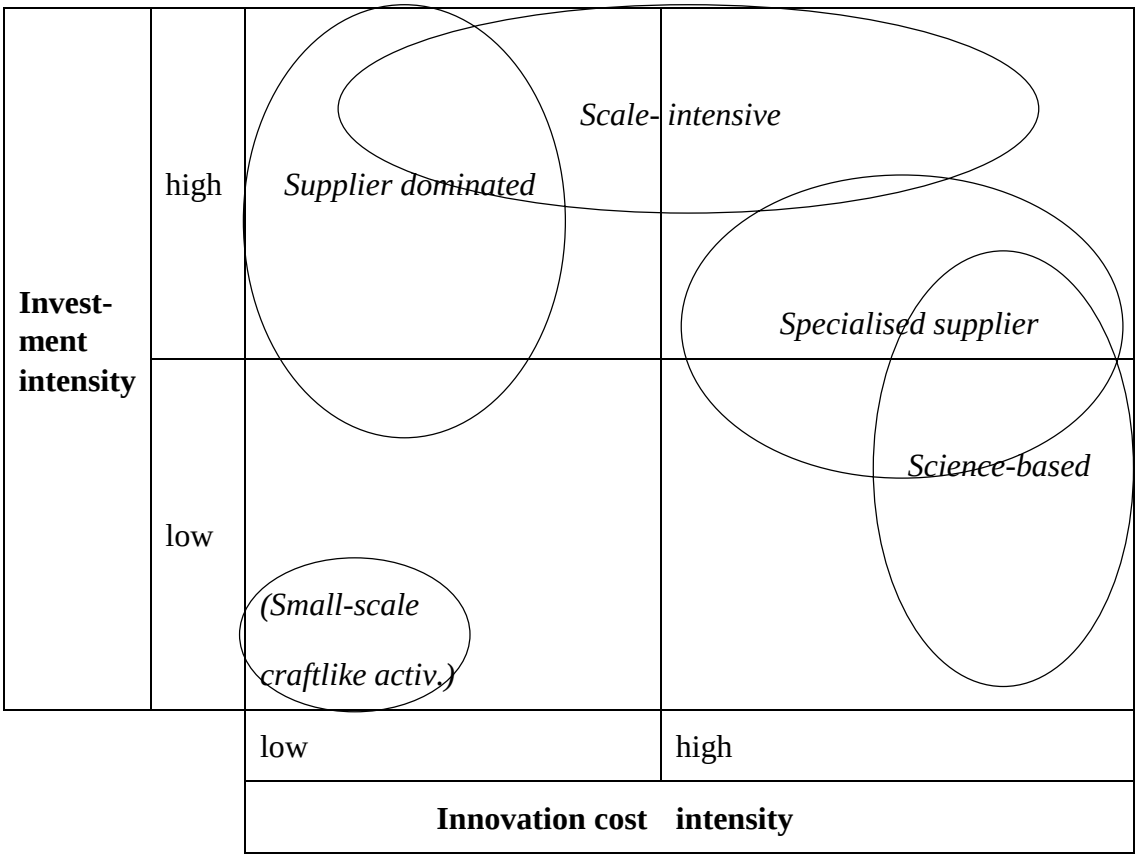

Figure 4.10 Investment and innovation cost intensity in technological trajectories.

This approach is likely to break down when there is either a high degree of customisation of the production or a rapid change in output qualities, implying significant barriers to identifiability in a static, resp. dynamic, context.[50] One aspect of this in the context of services is the inability to distinguish between product and process innovations.

The last point we will make is to point to the strong complementarities between what we in a wide sense term business or professional services and other sectors of the economy. As shown by some simple indicators, the particulars of services' role in structural changes emphasise these complementarities; the prominence of business (and other 'infrastructural') services in change processes show that the process is not an autonomous process located in the service industries. To further elaborate on this point, one could point to the 'genericity', or generality of use, of some of these professional services in terms of their producer-user linkages with other sectors. Some professional services, particularly financial and ICT services, have customers

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50 Using the static or 'reductionist' approach of technological change, with technological change reduced to efficiency increases in the use of capital and labour inputs, one runs the risk of seriously misrepresenting the effects of technological change in activities and industries where the rate of change is large. As we saw in section 2.xxxx one of the 'peculiar' aspects of some services was that concepts of 'quality' is dependent on user characteristics as well as 'product quality' proper. This implies that the more narrow economic impacts are difficult to separate from wider social impacts and the 'reductionist' approach will systematically underestimate the impacts of technological change (Soete and Miozzo 1989).

in a wide range of economic sectors, even if some of these relations might split into more specialised relations at a more disaggregated level.

As we have seen from previous sections the characterisation of services as labour intensive activities that are less, or not at all, amenable to productivity increases by technological progress leads to the 'cost disease' phenomenon. The slow or vanishing growth in labour productivity leads to a continual increase in relative prices for services. If this is correct it would seem unlikely that these industries will invest significantly in technology, structures or organisations. The increase in IT investments, to which we shall return below, the implementation of chain concepts in several services and the development of project based organisational structures f.i. in engineering services seem to run contrary to this point

Traditionally the investment profiles of several services, apart from physical services like transportation, have been heavily biased towards plant investments. These services could as well be characterised as 'plant-intensive', the flip side of their labour intensity and contemporaneous features of production and consumption. This picture has changed as a consequence of the development of advanced information technologies, such as network technologies and their integration with communication technologies and database management, with the necessary concomitant development of suitable high capacity hardware technologies. As stressed by Stephen Roach on several occasions (see next section) and reiterated by the recent National Academy of Science Commission (see NRC 1994), some service sectors are among the most capital intensive industrial sectors, and with service sectors accounting for about 80% of the IT hardware investment in the US economies. This is also true of the UK economy (Ducatel and Miles 1994).

Soete and Miozzo 1989 discuss an extension of the Pavitt taxonomy to services. Like most of the work that has been done in this area its focus is limited to technological change. Before embarking on the Soete/Miozzo taxonomy itself, we will discuss some general issues concerning the role of increased use of information technologies in services.

The increased flexibility and use of information technologies will inevitably increase the 'tradability' of services with a high content of information in the product. In services where communicating information is a significant element of the service provision, IT-based networks and software tools will reduce the need for close encounters between user and producer. Two trends increase the 'tradability' of these services; the split between 'production' and 'consumption', from con- to bi-temporaneousness makes the service product more identifiable and the use of IT enhances the possibilities of standardisation and generalisation of service products to several users. Thus one consequence to be expected is a diminishing share of 'customised' production in information intensive services. One way we would expect this to be expressed is through a development of new divisions of labour within the individual industries and enterprises. I.e., one possibly significant outcome of increases of IT intensity is an 'industrialisation' or 'modularization' of service production, with a

standardisation of 'component' production and customisation or 'tailoring' of architectural design (see Levitt 1976 and Sundbo 1994a).[51]

In several manufacturing industries on the other hand, the use of IT has the opposite effect (Soete and Miozzo 1989). Production systems like Just-In-Time production and implementation of Flexible Manufacturing Systems are heavily integrated with IT development, and aimed at reducing production lead times and flexibility, increases the 'service'-like aspects of manufacturing production. Thus we may conclude that the integration of IT development into service and manufacturing production leads to a convergence of important aspects of the two grand sectors.

We have on several occasions pointed to the complementarities between services and other economic sectors as significant factors behind the structural changes in the advanced economies. The significant outcome of this is that service functions within an industrial value chain, may not be treated as simple 'add-ons' on the production structure, but form important determining factors for the development of the production system. This is particularly expressed in production systems that are subject to considerable change in factors imposing on production methods and in characteristics of product demand. In industries in such production systems it is to be expected that the firm level bounded vision (Fransman 1990) and the absorptive capacity (Cohen and Levinthal 1989) will increasingly limit the strategic possibilities of each individual enterprise. At the same time a substantial rate of change in these factors increase the uncertainties and complexities that enterprises are faced with, factors that increasingly will require specialised assets to be met. As the costs of acquiring these specialised and complementary assets will be high and probably increasing, as we will see below, major technological change as well as significant changes in demand structures will strengthen these complementarities.

If we assume that these specialised assets are (primarily) organised within the firm, the cost associated with acquiring and using them will definitely increase. Two simple arguments show this. First within a company there is a larger wage 'mobility' in the sense of wage equalising factors across the organisational structure, implying that the service functions are expected to be boosted by spillover from 'productive' sectors of the company (this is essentially the Baumol argument of the cost disease, Baumol 1967, Baumol & al 1989) in a situation where these are not wage leading. As the strategic importance of some of these functions increase due to the processes described in the text, the costs associated with acquiring and using the assets will increase, giving central parts of these functions the role of wage leaders. This will be an effect of two processes, the internal 'competitive' edge of these functions as a result of their vitality to development of business strategies, and because the specialisation of the assets increases the scarcity of the 'core competencies' associated with them on firm-external labour markets.

We would expect the immediate consequence of this to be an increased externalisation of these functions. The increased complexities and uncertainties

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[51] This is a process that is particularly visible in the software development industries. An example is the use of generic software components to develop 'bespoke' or customized software 'architectures'

associated with the specialised assets create a scope mesmerisation of firm and industry specific needs. This will in the next instance create economies of scope for these functions, reinforced by an increasing 'genericity' of needs, allowing what might be termed standardised specialisation.

These processes imply directly that there will (often) be a significant gain in externalising some of these functions, at the same time as the 'interpretative' apparatus within the firm is developed further. So there will be complementary co-specialisation on both sides, in the service firm and in the 'client' company. In situations where the rapidity of change processes increases we would then expect to see an increase in employment of highly skilled white collar employees, such as scientists and engineers, in parallel. This is exactly what empirical data shows, ref. figure 1.2. In recent decades, though there has been a decrease in overall manufacturing employment ('de-industrialisation'), the growth of service employment, with a large share due to increases in the employment of 'white collared' staff with higher education[52], has been paralleled by an increase in high skilled white collar employment in manufacturing. The increase in business services employment has been concomitant with an 'upskilling' of the manufacturing employment.

What is essential here is that this analysis emphasises the strong complementarities between some service and manufacturing sectors, especially related to dynamic sectors of the economy. The kinds of service activities that these complementarities encompass, evidently include service functions related to generation, transmission, use and transformation of data, information and knowledge, i.e. the set of service functions we, following Miles & al 1995, have included in the category of knowledge intensive business services (KIBS). These 'core' services are themselves closely related, and have many features in common that make the term 'network' or 'infrastructure' activities plausible (Soete and Miozzo 1989).

The process of increasing complementarities between manufacturing and services is reinforced by the development of information and communication technologies. The increased 'tradability' created by information and communication technologies, as well as the efficiency enhancing effects of these technologies through computation capacities and increased search facilities, enhances the likelihood of the emergence of complementary 'core' services. But perhaps more important is the effect of these technologies to create scope for the development of qualitatively new services. Together these effects might promulgate dynamic learning, furthering integration between the sectors.

Table 4.13, adapted from Soete and Miozzo, summarises some of the features of different kinds of technological trajectories in services. The table is comparable to table 4.12 describing Pavitt's sectoral taxonomy for trajectories in manufacturing production. Three categories are distinguished; supplier dominated, scale intensive service trajectories and science based/specialised supplier services. It is difficult to

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52 Also reflecting the increasing level of average educational level in the economies.

distinguish between the last two as the services falling in this category are often closely related to information and knowledge generating processes.

Supplier dominated firms, encompassing the common perception of low wage service activities with small scope for productivity growth[53], even to the extent of questioning their productivity, may be found in personal services, like cleaning and laundry, hotels and restaurants, repair services (as well as Adam Smith's domestic servant and his descendants), as well as in public services, such as education, health and public administration, and retail trade. While firms of organisations providing public services are usually large, the other categories have traditionally been dominated by small organisations.

Even within this class of service firms there have been remarkable developments over the last few decades. F.i. within hotels and retail trade, companies have found it profitable to develop chain concepts that have considerably changed how these service sectors are organised and their relations with customers and suppliers. Even within 'low-skilled' services like cleaning there have been significant changes, as Sundbo's studies of the Danish multinational service company ISS have illustrated (see Sundbo 1994c). Starting out from cleaning services on the domestic market in the 1960s, ISS today employs around 140 000 in 17 foreign countries in Europe and the Americas, supplying a wide range of manual business services, such as environmental and other technical cleaning, catering, manual hospital services etc.

Scale intensive firms is in the table divided into two groups of firms; physical services like transportation and wholesale trade, and 'network' intensive firms or sectors such as banking, insurance and other financial services, as well as large scale communications services like broadcasting and other communication services with significant network externalities. As pointed out by Soete and Miozzo (1989) there is a wide range of reasons behind the growth of these services, also associated with significant productivity increases over the years.

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

The network intensity of these services make capacity utilisation and process flows critical. As pointed out by Rosenberg (Rosenberg 1976), and reiterated by Pavitt, production 'trouble shooting' enhances the development of in-house production engineering capacity, since "it is difficult to make ... scale-intensive processes work to full capacity. ... [T]rained and specialist groups for 'production' and 'process

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53 The archetypical services being shoe shining, hair cutting and hamburger flipping.

engineering' ... develop the capacity to identify technical imbalances and bottlenecks [improving] productivity", growing into a vital source of process technologies in these industries (Pavitt 1984). A similar pattern is visible in scale intensive services (Soete and Miozzo 1989).

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

As is evident from this analysis, several service sectors are central elements in the processes that with a misnomer has been termed 'de-industrialisation'[54]. The two 'grand sectors' of productive and value creating activities emerge as complementary, highly integrated and mutually dependent. The view that the shift in employment towards services is a shift from high-paid, skilled to low-paid unskilled labour, from productive manufacturing to unproductive personal services, does not concur with reality. As we have seen the sectors with the largest growth are 'advanced' services such as financial and business services, as well as social services and public administration, all to a large extent dependent on professional skills. The growth of professional business services is probably also underestimated as a consequence of the 'upskilling' in manufacturing industries,

> "The characteristic form of structural change ... does not involve a large net outflow of labour from manufacturing into nonmanufacturing employment; rather, it reflects more rapid employment growth in industries in which average wage rates currently are lower than in manufacturing. At the same time, however, the occupational structure of the US economy has shifted in the opposite direction, with faster growth in higher-skill, higher-wage occupations ... the gap in average wages between manufacturing and rapidly growing sectors such as business services ... has been shrinking over the past decade" (Cyert and Mowery 1987)

or as expressed by Guile 1988,

> "If the United States is becoming a nation of hamburger stands, it is also becoming a nation of management consultants, doctors, software designers, and international bankers"

We may conclude that there is ample indirect evidence and compelling indications that service sectors are major users, originators and transfer agents of technological

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54 The term 'deindustrialisation' evidently is evidently used with many meanings. The complementarity between 'core' service sectors and manufacturing industries points to the severe limitations of using simple indicators as share of employment or gross domestic product in manufacturing sectors as an indicator of a possibly real deindustrialisation in some national contexts.

and non-technological innovations, playing a major role in creating, gathering and diffusing organisational, institutional and social knowledge.

Table 4.13 Sectoral classification of technology trajectories in services. Adapted from Soete and Miozzo 1989

Trajectory	*Typical service sectors*	*Size of firms*	*Technology sources*[*]	*Main focus of innovation*	*Techno-logical capabilities*	*Appropriation*	*Innovation strategy*	*User req.*
Supplier dominated	Personal services	Small	Suppliers M	--	*Weak*	Non-technical	Product design	Performance sensitivity
	Public/-social services	Large/-Organi-sations	Suppliers M, S	Process	*Process know-how*	Restricted by public regulation	Performance improvement	Quality sensitivity
Scale-intensive physical network services	Transport Wholesale	Large	Suppliers M, S; in-house	Process	*System know-how, logistics*	Standards, norms	Cost reduction, networking	Price sensitivity
Scale-intensive information network services	Financial, communi-cation, media services	Large	Suppliers M, S	Process and product	*Network & service delivery*	Standards, norms; product different-iation and bundling	Networking, cost reduction	Price sensitivity
Specialised suppliers/ Science based	Business services	Small	In-house design and develop-ment; suppliers; users, education & science system	Product	*Process and context knowledge*	R&D, copyright, differentiation, know how bundling, cumula-tive learning	System design	Performance sensitivity

[*] M = manufacturing S = services

5 Mapping innovation in services

5.1 Innovation surveys - what is the picture?

A fast growing and massive investment in a rapidly changing technology would immediately be expected to have significant, even revolutionary, impact on the functioning of these services, both through 'first' and 'second order' learning effects at both firm and industry level. Increased R&D effort is a sign of deliberate attempts towards change. The dominant position of certain services in the employment of higher educated labour in the business sector point to a professionalisation of several services.

That is, we would expect to see dynamic innovation activity. But then the immediate question we meet is what the concept of innovation means for such services. With that concept of innovation as taken from manufacturing processes in the back of our mind, the focus on technological product and process innovations may be potentially misleading. The concept in itself is elusive. As any reader of the innovation literatures may ascertain there are many definitions of innovations around. Even in manufacturing, with processes of shorter life cycles and increased customisation and ability to handle highly specific demand characteristics, the identifiability of innovations is open to scrutiny. But rather than ponder the question of whether it is possible to delimit innovative phenomena in an analytical fashion, we will just note that the appearance of new services, attainment of new qualities and widening of scope of existing services, as well as restructuring of service operations are innovative phenomena as good as any other.

Probably a substantial part of the problem of capturing the innovative behaviour in several services is related to the conceptual framework used. As we noted in the preceding section the learning processes associated with new technology may be substantially extended over time, the effect being that the reorientation of company cultures, core competencies and company goals may not be distinguished as single events. In an environment of customised services, the relevant innovation may be associated with acquiring skills and knowledges that are transferable to custom production for other customers, but where these skills modify and extend the existing skills bases in a 'seamless' fashion. Nevertheless, as we now shall see, even with a restricted approach to innovation there is substantial evidence of innovation in services. Some attempts at measuring innovation in services at an aggregate level have been performed. Of broader surveys a number have been performed, but few haveas yet been reported in the research literatures:

- A Dutch survey of all industries, including services was performed in 1988 (Kleinknecht, Reijnen and Verweij 1990).
- An Australian (Pattinson & al 1995) and a Canadian (the Canadian survey has not published any results yet to our knowledge, the questionnaire is shown in Statistics Canada 1993) all industry survey, also covering service industries, was performed in 1993-94.
- The Community Innovation Survey was extended to service industries as a pilot survey in Germany and the Netherlands. The Dutch survey has briefly been

reported in Brouwer and Kleinknecht 1994, 1995. The German 1993 service survey was restricted to NACE section K, and is not yet reported (the manufacturing survey is presented in Felder & al 1995).

- A Swiss pilot survey in construction and service industries was performed by the ETH for the Bundesamt für Konjunkturfragen in 1994. The sample is small, there are responses from 77 service firms in all private service industries. The pilot survey is described in Etter 1995.
- More recently the German Bundesministerium für Forschung und Technologie has initiated a larger innovation survey of German service industries as a pilot for possible bi-annual service innovation survey. The survey is performed by the Zenter für Europäische Wirtschaftsforschung (ZEW), together with Fraunhofer Institute for systems and innovation research (FhG ISI) and infas Sozialforschung (Licht &al 1996, see also Hipp, Kukuk, Licht and Münt 1996).
- Presently the Italian institute ISRDS under the national research council and Statistics Sweden is performing a more explorative interview based survey of innovation in forty service firms, on the initiative of the Eurostat/DGXIII SPRINT/EIMS (European Innovation Monitoring System) programme.
- A similar Eurostat initiative was behind a Dutch interview survey on innovation in wholesale and retail trade, transport and communication, banking and insurance, computer service and software industry and engineering and technical consultancy (Statistics Netherlands 1995). 13 firms were interviewed.

Within the framework of OECD, work is beingcarried out to revise the Oslo Manual (OECD 1992a) on innovation indicators, and considerable emphasis has been put on extending the manual to service sectors. The revised manual is expected to be published later this year or early in 1997 and will form the basis of the next round of Community Innovation Surveys, scheduled for 1997.

The international group of representatives of statistical offices, the Voorburg group, has initiated work to design an innovation survey format for service industries (Gault and Pattinson 1994, 1995), a process that has been integrated into the OECD revision process of the Oslo Manual. As a consequence no survey has as yet been performed on the basis of this work.

Generally speaking most of these surveys have a fairly strong technology dimension. The German and Dutch CIS extensions, as well as the Voorburg suggestion, used the CIS questionnaire as a basis for designing the surveys. This dimension may be illustrated by the phrasing of the Dutch CIS service survey, which typically defines innovations as

> "development or introduction of new or improved products or services [as opposed to technologically new or improved ... for the manufacturing sectors], [noting that innovations can consist of] the use of a new or improved technology or an original application of an existing technology"

Table 5.1 Profile of service innovation surveys. The table covers the surveys with a 'general' coverage of service industries.

Survey organization	***Voor-burg Group***	***MEZ SEO***	***Statistics Canada***	***Australian Bureau of Statistics***	***BFK ETH***	***BMFT ISI ZEW infas***	***Eurostat Stat Neth.lnds***	***Eurostat Stat Swe ISDS***
	Model quest.	*Dutch in. surv.*	*Canadian S&T Survey*	*General survey*	*Schweiz small scale pilot*	*German Pilot survey*	*'Case'-scale pilot*	*'Case'-scale pilot*
Type:	-	*postal*	*postal*	*postal*	*postal*	*postal*	*interview*	*interview*
Performed:	-	*1993*	*1993*	*1994*	*1994*	*1995*	*1995*	*1996*
Coverage	-	*All*	*All*	*All*	*Serv. + Const.*	*Services*	*Selected serv.*	*Selected serv.*
1 *General information*	+	+	+	+	+	+	+	+
2 *Sources of information*	+	-	+	-	+	+	-	-
3 *Objectives of innovation*	-	-	+	-	+	-	-	+
4 *Acquisition of technology*	-	-	+	-	-	(+) IT	-	-
5 *R&D activity*	-	+	+	-	-	+	-	-
6 *Factors hampering innovation*	+	-	+	-	+	+	-	+
7 *Costs of innovation*	+	+	(+)	-	(+)	(+)	(+)	+
8 *Impact of innovation activities*	+	+	+	-	(0)	+ (incl. employment)	+	+ (incl. Employment)
9 *Other*		Part of CIS	'Tick-a-box' type quest. - Broad technology use focus, innovation part focusing 'most important innovation'	Emphasis of non-techno-logical innov. - Innovation examples	- Cooperation - Innovation examples	- Innovation examples - org. innovation - human capital	Q related to conceptual issues	Q related to conceptual issues -Examples

None of these surveys, apart from the Australian and German surveys, has made attempts to include organisational innovations. Furthermore other innovations with a diffuse or weak technology link are possibly excluded from the surveys, due to non-existence or low visibility of technology links[55]. The list of innovations mentioned by the respondents in the Australian survey included in addition 'non-technological' innovations, specified in the questionnaire as implementation of

- advanced management techniques,
- significantly changed organisational structures,
- new or substantially changed corporate directions.

Using the sections of the CIS questionnaire as framework, the profile of some of these surveys may be illustrated as in table 5.1.

In comparing the results of the various surveys, several idiosyncrasies of the individual ones restrict the availability of comparable indicators, both among sectors and between countries. However, taking at face value the data from the Australian and Dutch surveys, as reported in Pattinson & al 1995 and Brouwer and Kleinknecht 1995, table 5.2 shows the share of firms undertaking innovative activities in several service industries. In reading this table note should first be made of the variations in sectoral composition of service sectors. Secondly note that the Australian service survey asked for innovative activities undertaken in the last year before the survey (July 1993 to June 1994), whereas the Dutch survey asked for innovative activities in the period 1990-1992. Thirdly the Dutch results have been scaled to national totals, i.e., the numbers should approximate the 'true' fraction of firms in any industry undertaking innovative activities, while the Australian figures are given as fractions of firms in the sample.

Comparing services and manufacturing *averages* we hide inter-industrial variations within each of these 'grand sectors', but they nevertheless suggest three conclusions:

- the overall pattern seems to be roughly consistent between the two countries,
- the fraction of service firms undertaking innovative activities is somewhat smaller in service than in manufacturing industries, primarily as regards technological innovations where the figures suggest that on the average 1 in 3 manufacturing companies are innovative in this sense, whereas about 1 in 5 service companies belong to this group,
- the Australian data suggest a difference in the balance between technological and non-technological innovative efforts by service and manufacturing companies, with non-technological innovative effort being relatively more frequent in services than in manufacturing.

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55 The respondents eagerness to describe innovations considered important, however weak the technology link, may work in the opposite direction.

Table 5.2 Share of firms undertaking innovative activities. Percent. Australia and the Netherlands.[*] Source: Pattinson & al 1995, Brouwer and Kleinknecht 1995

	Australia		*Netherlands*
Sector	***Technological innovations***	***Non-technological innovations***	***Product innovation activities***
Wholesale trade	18,0	25,9	
Retail trade	12,8	7,2	22,2
Hotels and restaurants	10,6	15,9	18,8
Transport	6,5	12,9	
Communication	20,9	18,2	16,7
Finance and insurance	7,0	11,0	31,7
Property and business services	11,4	14,6	33,3[**]
Education	17,0	23,1	
Health and community services	10,4	16,4	29,9[***]
Cultural and recreational	19,9	17,6	
Personal and other	9,2	15,4	
Services	11,5	13,9	22,3[****]
Manufacturing	33,7	24,2	39,0

[*] Australian numbers are *shares of respondents* indicating innovative activities, Dutch numbers are scaled to *national shares*. This will probably, due to the design of sample frames, affect comparability of industries that are most dominated by SMEs the most. Furthermore Australian service data refer to innovative activities undertaken during the *last year*, whereas manufacturing and all Dutch refer to activities undertaken during the *last three years*.

[**] Other commercial services.

[***] Other non-commercial services. Includes R&D labs.

[****] Service total include EGW utilities and construction in the Dutch results.

Apart from the 'innovativeness' of wholesale trade in the Australian data, the fractions give rough confirmation of the picture that emerged from R&D data, namely that science and technology based services, like communication and some business services, show up as more intensive than other types of services.

Structural characteristics within the 'grand sectors' limit the comparability between the two countries, beyond the 'peculiarities' of the two surveys. Some of the categories given in the table are heterogeneous, in terms of composition grouping together lines of businesses that may f.i. have different size characteristics.[56] Even though the figures suggest a roughly consistent inter-industrial pattern in terms of innovativeness, the difference in the reported figures for financial institutions is striking. The reason should probably be sought in differences in national specificities of the industry.

One hypothesis would be that a large part of the difference between services and manufacturing is explainable by the difference in size distribution in the two sectors; i.e., that the lower fraction of innovative firms in services is due to the larger share of small or medium-sized enterprises in services. It is well established that R&D and innovation intensities show strong variations with firm size (see f.i. discussion in Cohen and Levin 1989), with a larger share of innovative enterprises among the larger ones.

The size dependence of firm level intensity of innovative activities among innovative firms is, however, uncertain, with some suggestions of a U-shaped curve. Brouwer and Kleinknecht 1994 give the size distribution of innovative activity, comparing services and manufacturing, cf. table 5.3. The structure of the table suggests that there is a difference to innovative activities beyond size effects, with a lesser share of innovative companies in services for all size classes. The relative gap between services and manufacturing shows, however, a rapid diminution with increasing size (for activities oriented towards product innovations the gap is 75% for the 20-49 size class, reduced to 15% for the over 500 class). Secondly, whereas the frequency of product and process related activities are roughly the same for manufacturing industries the gap is larger for service industries. This may be a reflection of the greater difficulty in distinguishing process innovations for certain services (cf. f.i. Statistics Netherlands 1995).

Table 5.3 Share of innovative firms according to size, national totals in the Netherlands. Percent. Source: Brouwer and Kleinknecht 1994

	Size	*10-19*	*20-49*	*50-99*	*100-199*	*200-499*	*500+*	*Total*
Mfg.	*Product*	24	35	57	64	70	77	39
	Process	23	35	53	62	72	80	38
Serv.	*Product*	18	20	35	42	49	67	22
	Process	6	15	23	27	46	56	13

We may conclude that service companies innovate. Combining this survey with the description of R&D activities, we get a picture of diffuse innovation processes that

[56] As the table describes shares of number of firms, a category including one small scale SME dominated line of business and one scale intensive LEN dominated, the numbers in the table may be dominated by the SME line of business, even though this line may be marginal in terms of employment and turnover.

are quite often difficult to distinguish. In the study of financial services, electronic information services and management consultancy industries for the French Ministry of Higher Education and Research, Gadrey & al 1993 confirmed this assumption; innovative activities were often informal and widely spread out in the organisation. Innovation processes were often ad hoc, but they found an increasing tendency to formalise the process. A few service firms had separate departments with responsibility for innovation and development, but they seldom had the characteristics of R&D departments. The only exception of this was electronic information services; the only industry where service innovations were science based. In accordance with the conclusion drawn by Sundbo 1994b in a study of financial services, tourism and management consultancy, "service innovations are not science based". At the other extreme, innovation in management consultancy emerged from a sort of collective process involving the professional staff of the consultancy firm.

5.2 Case based approaches

The weaker science base of services innovations may in part explain the weaker integration of services with public scientific and technological infrastructures. See f.i. table 4.3 where the share of outcontracted R&D is negligible in many service categories, except for the category involving engineering and architectural services. This suggests that the characteristics of innovative activities in services are not reflected in the often technology (and natural science) dominated character of public infrastructures. This may open up for rather different characteristics being required for innovation infrastructures for various service industries. Secondly it points to the possibility of a rather different character of knowledge bases in services, as compared to other economic sectors. In a study of the French insurance company UAP, Gadrey and Gallouj 1994 list 17 different scientific areas mobilised in UAP, of which more than half relate to social sciences.

The strong customer integration and co-production in service production (cf. f.i. Czepiel & al 1985, deBandt and Gadrey 1994 and Miles & al 1995) opens up for an integration of the customer in the innovation process, to the extent of making innovation closely related to - or even indistinguishable from - processes of customisation. This possibility would seem to afford a potential for competitive advantage for these firms, both as regards innovative features of the customisation in itself, and the possibility of learning that may permeate other producer-user interfaces. But apart from electronic information services, which had quite extensive external networks, according to the French study, service firms are not particularly efficient in establishing external networks, or in involving the customers in the innovation process.

Probably the most widely studied area of innovation in services is financial innovation. The literature may concern the role of technology in the development of financial services or organisations (as Barras 1986, 1990 (see below), Bilderbeek and Buitelaar 1992, Buzzachi, Colombo and Mariotti 1995, Dover 1987, Fincham & al 1994, Guile and Quinn 1988a and 1988b, Harris and Katz 1991, Scarbrough and Lannon 1989), other focus management and organisation of innovation (see Tremblay 1990a and 1990b, Sundbo 1992 and 1995, Martin and Horne 1993). Yet

others focus on the development of new and reorganised financial instruments and on the processes behind these (as Llewellyn 1992).

The reasons for this focus may be various, some far-reaching, such as Barras' characterisation of financial and business services as the 'vanguard' sector of a IT-based 'service revolution', according the role of IT in these services the same role as some observers have accorded mechanisation in the cotton industry during the industrial revolution in the early nineteenth century. Other reasons may be more pragmatic, in terms of visibility of changes and their effects. As most financial activities involve storage and updating of large data sets, it comes as no surprise that information technologies have been decisive in reshaping financial services over the last three decades, both directly in creating new technology based services and in developing an infrastructure that widens the applicability of new financial instruments.

Increased use of IT has widened the range of potential products and the possibilities for segmentation of product and customer categories and reduced dependence on geographic location. Another striking aspect of financial services over the last decades is increased internationalisation, often complementary to the development of new financial instruments and markets. These processes are not simply technology push processes, but equally dependent on regulation structures and corporate governance. The changes in these regulative structures (through 'deregulation') have had an equally decisive impact on the reshaping of these industries.

Reidenbach and Moak (1986) and Reidenbach and Grubs (1987), studying innovation in US banking, concluded that US banks lagged behind manufacturing industries and to a certain degree behind other service sectors in innovation activities. The US banking industry did not regard innovations as a significant development factor and innovation activities were not organised systematically. The banks that used innovation performed better than other banks. The assessment of retail banking in the US and Europe by McKinsey Institute (McKinsey Institute 1992, Baily 1993) concluded that there was a significant productivity advantage in US banking. This would suggest that the potential for improvement is even larger in European banking, a point finding support in a study of 'computerisation' in the Dutch banking sector, "within the Dutch banking sector [attempts at organisational innovation] have been characterised by partial, segmented reforms ... Steps towards the necessary integrated innovations have not been taken yet" (Bilderbeek and Buitelaar 1992). Sundbo 1994b points to the same features in Danish financial services, of a weak consciousness of innovation as an instrument for business development.

Näslund 1986 noted that banks innovate, but under different conditions than manufacturing firms. But financial innovations appear to be more easily imitated than other innovations. This has been identified as a reason for the low innovativeness of banks (Sundbo 1995); easy imitation may reduce the incentive to innovate by eradicating the possibilities for appropriation of benefits, a point that is particularly emphasised by the lack of intellectual property rights.

Table 5.4 Fifteen case studies of innovation in KIBS. Source: Bilderbeek & al 1994

	Service	*Description*
	Telematics	
1	*Fleet management systems services*	Using mobile satellite data communication, global positioning, routing & planning software for truck fleet management
2	*Product Data Interchange in architecture*	Exchange of technical data between actors in building process
3	*Computer continuity services*	Provision of back-up facilities and services in case of internal computer system breakdown
4	*Teleworking services*	Provision of infrastructural facilities for teleworking and teleemployment agencies
	Multimedia	
5	*Multimedia in corporate training services*	Use of multimedia in service companies specialised in corporate training
6	*Video-conferencing services*	Applying multimedia in in-firm, intra-mural telephone communication and conferencing
7	*Multimedia in pharmaceutical marketing*	Using multimedia for pharmaceutical products marketing
8	*Multimedia in legal practice*	Multimedia publishing. Use of multimedia in the provision of law data
	Environmental technologies	
9	*Laboratory informatics and management systems services*	Provision of on-line data from contaminated soil analysis for continuous soil data management
10	*GIS-related environmental consultancy services*	Use of Geographical information system for preparing and planning in-site clean-up
11	*Environmental data provision services*	Environmental information services (data, maps consultancy) based on remote sensing data
12	*Waste exchange services*	Consultancy services aimed at minimising waste and dealing with waste according to existing regulations
13	*Eco-product design services*	Services aimed at providing sustainable product design
14	*Environmental feasibility studies*	Environmental consultancy services on the basis of environmental auditing and impact assessment
15	*Waste reduction services*	Integration of waste reduction strategies as part of total waste management services

In a recent project for the DGXIII SPRINT/EIMS programme, Bilderbeek & al 1994 report on 15 studies of innovation in knowledge intensive business services, performed in conjunction with the EIMS report Miles, Kastrinos, Bilderbeek and den Hertog 1995. The fifteen case studies are described in table 5.4.

These case studies are quite varied in terms of the number of firms involved in each case, the 'export' or domestic orientation of these firms, characteristics of the innovations, as product vs. process and technological vs. organisational foci, the role played by regulation, firm size, etc., so there it is unsurprising that the innovations also differ in terms of how the innovation processes develop and are organised, and in terms of impact of the innovation.

Though the case studies involve users of technology, several case studies involve development of new technological solutions, structures or products that have wider impacts beyond firm boundaries; they play an active role as technology developers, in contrast with the received view of their supplier dominance. The innovations studied often have a high information content, an information intensity that creates the need to develop new competencies. What these competence needs are and how the information intensity is expressed varies, as seen in firms' responses in terms of appropriation, from embodying strategies to extensive customisation (see Kastrinos and Miles 1995b).

In discussing the pattern that emerged from the fifteen case studies, Bilderbeek & al note that they give reason to conclude that services' innovation "differ substantially from 'traditional' innovation processes". They note that evidence of a fuzzy character of innovation processes is related to

* strong interdependencies along the (technology supplier- service provider-service user chain,
* the innovations often being simultaneously product, process and delivery innovations,
* appropriation opportunities.

As the set of cases gives a strong selection bias to the effect of appropriation strategies, this study cannot answer the question of whether appropriability regimes in services are limited and what the effects are. Nevertheless the study shows that there is a diversity in terms of options of appropriation of innovations (ref. table 5.5 below). On the basis of the case studies, it is suggested that they fall into six generalised patterns,

* embodiment of service innovations,
* embedding innovations in a service delivery system,
* creation of entry barriers, such as delivery systems or infrastructures,
* continuous innovation as a 'fly ahead' strategy,
* formation of strategic alliances or collaborations,
* strengthening of user-producer relations.

The interactive character of the innovations support the conclusion that the innovations are difficult to characterise as supply- or demand-driven. Of the four innovations that are classified as predominantly supply-driven, three are in a sector with a strong technology-push character, the multimedia sector.

Table 5.5 Appropriation mechanisms and innovation characteristics in KIBS. Source: Bilderbeek & al 1994

	Service	*Appropriation*	*Driver (Supply S, Demand D)*	*R&D*
	Telematics			
1	*Fleet management systems*	-	S + D	In-firm; technical options, debugging, selecting telematics; supplier collaboration
2	*PDI in architecture*	Standards	D	Outsourced; technical standards
3	*Computer continuity*	Disaster recovery centres	S + D	In-firm; expl. new markets, cheaper hardware
4	*Teleworking*	Telework agencies Software for customised applications	D	External support; market research; technical consultancy/PTT
	Multimedia			
5	*Corporate training*	Client specific courseware User-adaptable platforms	D	In-firm; digital video techniques, CD-I; client intense
6	*Video-conferencing*	VC-systems VC-services	S	In-firm; VC-based service dev.; client coll.
7	*Pharmaceutical marketing*	Interactive CD	S	In-firm; CD-I; external assistance
8	*Legal practice*	CD-ROM	S	Outsourced; CD-ROM, market research
	Environmental technologies			
9	*Management systems*	Soil data management software	First S, then D	Init. outsourced, later in-firm; environm. techn., automation
10	*Environmental consultancy*	GIS-application	D	In-firm; R&D in ‘grey hours’
11	*Environmental data provision*	Client specified data	S	In-firm; HSW dvlpmnt, data services, market research
12	*Waste exchange*	Database Patents	D	In-firm; materials recovery, recycling
13	*Eco-product design*	Product designs	S + D	In-firm; project-bound
14	*Environmental feasibility*	Software	S + D	In-firm; project-bound or selective strategic
15	*Waste reduction*	Standardised waste audit	S + D	In-firm; project-bound

Though some of the cases conform with the general ideas concerning formalised technological R&D, the overall picture suggests a wider R&D concept, both in terms of what types of activities are considered relevant for this heading by the firms, such as software development and market research, and in terms of the extensionality of the activities. In particular the integration of such activities and ongoing projects, i.e., R&D organised as an ad hoc activity seem to be frequent, and more so for 'knowledge intense' innovations; R&D is characterised as 'client-led' and 'project-bound'. In line with this, R&D is predominately performed as an in- house or a corporate activity. There are few, if any, indications of collaborations with a technological infrastructure beyond industry-based R&D organisations. In general the pattern that emerges, seems to confirm the pattern suggested by survey based approaches to the character of R&D in services, cf. in particular table 4.3.

Though the characterisation of the firms involved in the fifteen cases suggests that the existence of a formalised approach to R&D in several instances, few of the 33 firms have established any R&D departments. Those that use such facilities are dominated by the firms that are parts of larger, even multinational enterprises, with a considerable R&D culture and organisation, and where the service subsidiary involved in the study may rely on R&D activities or technical expertise within the enterprise.

6 Analytical approaches to innovation in services[57]

6.1 Introduction

The set of literature on innovation in services is thin relative to the corresponding literatures for manufacturing. Little has been done to approach the topic analytically and theoretically (see however Barras 1986 and 1990, Eiglier and Langeard 1987, Gallouj 1994a, Miles & al 1995, Normann 1991, Sundbo 1994a and 1995), but any attempt to remedy this will soon come up against weak empirical data and descriptions of these processes and their characteristics. In addition to works that have already been surveyed, additional empirical studies of innovation in service firms have been performed. But no attempt has yet been made to collate this literaturemore systematically and assess the overall picture.

In the theoretical debates of the growth of services (a review of this literature is given in Stehr 1994) in post-industrial societies, self-service economies and knowledge societies, the question of innovation in services seems to remarkably absent. The general idea seems to be that services do not innovate. This paradox seems even greater when one considers that these services often employ substantial parts, if not dominant parts, of the labour force with tertiary level education.

On the other hand a growing literature on the topic of innovation in services allow an attempt at a preliminary classification. Such a classification of innovation processes has been attempted in Miles & al 1995 for the case of knowledge intensive services (KIBS), and more broadly in Gallouj, F. 1994a. Following Gallouj, we may group the approaches to innovation in services in three,

- technology based approaches, focusing on the role of technology in services,
- 'service' based approaches, emphasising the 'peculiarities' of services and service production,
- integrated approaches, where the complementarity and convergence of service and material goods production is stressed.

Gallouj argues that most of the work that has been done on innovation in services has a strong technological dimension; the questions being asked are based on an approach of adoption of external technologies, and often focus on impacts of this adoption and the associated accommodation processes. To a certain extent this literature is based on the assumption that the general approaches to and methodologies of (technological) innovation in manufacturing industries are applicable to the major part of service industries, though possibly with modified characteristics.

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[57] This section has benefited from an undated note Gallouj, C. and Gallouj F., *Innovation in services: A survey of the literature (Version provisoire)* (in French)

These approaches, though valuable, are often claimed to be insufficient to understand innovation in services. This has led to a growing alternative literature emphasising what we described as peculiarities of services and their relation to the constitution of innovation processes. In particular the co-production of service provider and client is a central feature of the concept of 'servuction' (Eiglier and Langeard 1987), seen as the characteristic distinguishing *serv*ice prod*uction* from production of material goods. This client specificity of individual services suggests considerably complicated innovation processes; the 'black-boxing' of innovative ideas independent of specificities of individual clients is no longer direct and immediate.

Hence the problem of innovation in client intensive services may be said to be the opposite of what Lundvall 1992b pointed to. He noted that the difficulty in attaining effective information exchange and mutual learning along inter-firm user-producer relations severely limits the ability to generate innovations, particularly where the relations involve complex and rapidly changing technologies. In these circumstances innovations may need to be highly customised; the need will be for direct co-operation between the producer and user, for a *coproduction* of innovations. This leads to the development of the kind of relations that are stressed by the 'peculiarities' approach to service innovation, co-operative links based on intimate and long lasting relationships, with mutual trust as a decisive competition characteristic. For client intensive services, where the user-producer relation may be strongly intertwined, the problem may be regarded as overcoming these client specificities and identifying client generic aspects that are transferable to other client relations; of 'black-boxing' innovations. These considerations open up for the integrated approaches to service innovations.

These approaches have emphasised that peculiar features of service innovation are increasingly also characterising manufacturing innovation, leading to attempts to develop general theories and approaches to innovation, independent of any service/product distinction. The ultimate objectives of such 'reconciliatory' approaches have been expressed by Moulaert 1988 (as cited in Gallouj, F. 1994),

> "the 'tertiary' critique of neoclassical theory may lead to an opposition between 'manufacturing' and 'tertiary' economic analysis. Such an opposition ... contributes little to the integration of economic analysis of contemporary society; on the contrary, a 'tertiary' critique of economic theory is only valuable by contributing to the formation of a theory that is able to analyse the development of new utilities and their new production and exchange processes, *independent of their manufacturing or tertiary nature*" (our translation and emphasis).

Nowhere is this integrative approach more prominent than in the writings of analyser of corporate strategy J. Brian Quinn (see Quinn 1992), where the 'service revolution' is perceived as reconstituting the major competitive assets in all economic sectors; service functions "occupy the critical spots in most companies' value chains".

6.2 Technology based approaches

6.2.1 Technology impact on services

The literature on the impact of information technologies on services can be classified according to two broad models, each characterised by a set of impact dimensions such as employment, productivity, qualifications and tradability, as illustrated in table 6.1. The first of the two model approaches that we can distinguish corresponds to the introduction of centralised information and computing systems, while the second to adoption of decentralised network technologies. Even though the two models may be regarded as a causal chain of the development of information technologies, there is no causality implied between the two models. On the contrary, in terms of information technologies the two technologies live side by side, corresponding to complementary information structures and tasks in various service industries.

Table 6.1 Analytical approaches to technological innovation in services. Source: Gallouj 1994a

	Model 1 Centralised information structures	**Model 2 Distributed information structures**
Employment		
Qualification and organisation of work		
Productivity		
Tradability		
Service product		

In the first model the focus is on productivity growth and impact on employment, standardisation of service products, development of Fordist work organisation and a de-skilling of the labour force, as well as exploiting scale economies; that is they are primarily efficiency oriented. As suggested by Gallouj 1994, this may be termed 'back office' automation; the intention behind the new technology is primarily to increase the efficiency of existing services. 'Back offices' are usually data processing intensive and often amenable to standardisation.

A standardisation opens up for increased division of labour and routinisation, allowing a greater separation of these functions from the 'front office' production. This is evidently particularly valid for scale intensive services, such as banking and insurance, where the introduction of computer systems also led to an administrative centralisation, moving tasks from the 'front' to the 'back office' (Fincham & al 1994). Development of tele-related infrastructures and of standardised interfaces between 'back office' and 'front office' functions, open up for a relocation and geographical separation of 'back offices' (Illeris 1989), or for a restructuring of existing industries by opening new scale economies (such a process may come towards explaining a restructuring of trade industries and hotels, as horizontal and vertical integration f.i. in chain concepts).

The second model, introduction of distributed minicomputer systems, of network technologies and on-line services, would seem to offer potentials of further productivity enhancements, through increased flexibility and development of scope economies. To the degree that the first lead to a de-skilling of the labour force, one may hypothesise that distributed information work might lead to re-skilling. Distributed information structures and the associated work organisation shifts the focus from 'back office' to 'front office' functions.

Only to a limited degree do these approaches specifically focus on innovation in services; an innovation focus is secondary to the main interests of this literature. As is evident from the distinction of two model approaches, this may be justifiable in the case of the first model, but less so in terms of the second.

6.2.2 The role of technology in services

The critique that may be raised against aggregate approaches to the impact of technology on services is that they contribute little to the understanding of the mechanisms behind the appearance of new services and the changes to old ones. By focusing exclusively on the unidirectional link from technology to services, their ability to explain the dynamic aspects of the development of services is limited. On the other hand the present understanding of service dynamics is far too limited to describe these processes to afford suggestions for the further development of this research area.

What we may do is to suggest a set of different channels of interaction between technology and services. In each of these channels there is a mutual interaction between technology and services, extending over time, that contributes to shaping both the service and the technology. The following five channels of interaction are suggested.

- *Substitution*. The simplest category is service provision by a technical device operated by the customer, that directly substitutes a service formerly provided by service personnel. The service is standardised or automated, from the perspective of the service provider; that is, the customising dialogue is left to the customer interacting with the technology. As services rendered to external customers these innovations would be examples of delivery innovations in the terminology of Miles & al 1995, of a type where the service increases the customers' uni-lateral specification. But note that the substitution is not limited to the external relations of the service provider, it may equally be valid for internal service provision, f.i. between back- and front-office functions.

  Even though the substitution act may be fairly simple, the long term effects may be considerable. However, based on a review of the quite extensive literature on the effects of the automatic teller machines (ATMs), the ability to measure positive economic returns from the technology, is limited. The correlation between the introduction of ATMs in banking, since their first introduction in 1969, and changes in retail banking is weak (see Brown, Haynes and Saunders 1990). But they have given opportunity for gaining sustained market shares (dos Santos and Peffer 1995), as well as creating incentives for a common delivery

infrastructure, with standardisation of card formats and operation procedures (as PIN-codes) based on inter-bank use of bank cards (Fincham & al 1994).

- *Definition*. When new technological opportunities create possibilities of new services based on or constituted by new technological devices, we may regard the technology and service as essentially the same thing. Access to the new technology requires the contingent existence of a complementary service, where in a restricted sense we may regard the service and the technology as effectively identical. Classic examples of such innovations include telephony and broadcasting, where the technology affords the necessary 'hardware' infrastructure, while the service is providing the necessary 'software'.

- *Determination*. Technological innovations may be decisive for the appearance of new services or for changed aspects or functions in existing services without the constitutive complementarity of the preceding point.

  There may still be a strong link between the two, however, as in the case of professional and support services related to information technology. Such services, comprising system and software development, system design, training, IT consultancy etc., even when restricted to IT purposes alone, represent a considerable share of the overall global IT market. According to OECD 1996c the services market is about 40% (excluding packaged software and related support) of the IT market, representing about 125 billion US$ in 1994.

  In a slightly wider context the introduction of new technology may reshape existing services, such as management consultancy. Finally technological systems widen the scope of services, or create the opportunities of new, as for technical consultancy.

- *Diffusion*. The role of services in diffusing technological and organisational innovations may be significant. The most immediate example is the role of IT-based services, (Moulaert & al 1990), but the role of services in diffusing innovations is wider than this (Bessant and Rush 1995, OECD 1995b).

- *Production*. Service companies may also develop technological innovations themselves or spur technological innovation in client companies. Again it is easy to think of IT examples, but it is equally valid for other service sectors, such as in logistical and transport services. The development of a new catamaran by the Swedish ferry company Silja Line is a case at hand. Being users and promoters of specific technologies they will also have considerable impact on the technological development of their technology suppliers; just as the development of database management systems during the 1960s were prompted by needs in the financial sectors (Fincham & al 1994). The role of an integrated relationship between airline companies and the airlines in the development of new aircrafts is evident, as is the similar relation in other transport sectors. In several instances it may be difficult to ascertain where the innovation has been made; the innovation requiring intense interaction between technology providers and users, such as in specialised niches in naval transport. The distributing sector of products from the food

industry may have considerable impact on shaping quality or environmental requirements of food products (Miles and Wyatt 1991).

Together these considerations show that different services do not performthe role of passive adopter of technology, but rather that they play an active role, comparable, at least in kind, to that of manufacturing industries.

6.2.3 The reverse product cycle

The structure of the RPC

Barras' model is one of the few attempts to develop a genuine innovation theory for services (Barras 1986 and 1990). His work has a strong technological underpinning; it attempts to generate a theory for the accommodation of new technologies in services. The central concept in this framework is the 'reverse product cycle', where the 'normal' product cycle in the sense of Abernathy and Utterback (Abernathy and Utterback 1978 and 1982) is reversed, running from efficiency enhancing incremental process innovations, via quality improving process innovations, to product innovations through the appearance of new services. Although he states initially that the aim is to develop a general theory for the uptake of new technologies in user industries in general, his empirical basis and focus is throughout on services.

The model is based on the assumptions that new technologies are developed in a capital goods sector, where the reverse product cycle may be regarded as the effects of the accommodation of the new technology in service industries. But by focusing on the dynamic relationships between the technology and the service industries, it is not a theory of adoption of exogenously given technologies; on the contrary the cycle contributes to the shaping of the technologies. There is a dual relation between the normal cycle in the capital goods industry, such as the IT industry, and the reversed cycle in the user industry; there will be considerable feedback and interaction between the two processes. On the basis of studies of adoption and impact of information technologies in UK financial services, accountancy and local government, he concludes that innovation associated with this inflow of a technology wave in these service sectors generally follows this reversed pattern.

Phase 1: Improved efficiency

The first stage in the reversed cycle is initiated by the users' adoption of the new technology, originating in the manufacturing sector. The adoption process will focus on incremental process innovations aimed at cost saving and (production) efficiency enhancement. With the labour intensity of services, the process will be characterised by capital-deepening, labour saving technical change. In terms of the two models considered above, this corresponds to the first one, introduction of centralised information systems, in particular the introduction of mainframe systems, with a strong focus on cost efficient 'back-office' functions.

The adoptive processes of this first stage may be termed 'non-programmed' innovation, they are associated with incremental innovations, accommodating the new technology in the user industry, while building up technological proficiency

and absorptive capacity. Hence we would not expect to see the adopters engaging actively in R&D activities at this stage; unless, that is, they have a previous record for being R&D performers.

The impact of the first phase of the reversed cycle may take a long time to develop; the potential benefits are dependent on contingent factors besides the deployment of the technical solutions themselves. This points back to the importance of learning effects, where it may take considerable time to allow the adopter to fully reap the potential benefits from the new technology. But equally important is that the technology that is imported is not stationary; the technology may over time grow more amenable to adoption for the service processes considered, possibly under influence by requirements from the user industry. Equally, the service processes themselves may change over time making them more amenable to 'standardisation' by technology.

Phase 2: Improved quality

The next phase is initiated as the first one is fully realised, where the focus shifts from efficiency to effectivity; to quality improvements rather than cost reductions; from 'back' to 'front office'. As in the previous stage, the focus is still on improvements within existing services, even though the stage may involve considerable reshaping of these services; ATMs in financial services is one example. Barras' outline of the cycle under the influence of IT associates the second stage with on-line systems and the development of mini- and micro-computer systems. It is unclear to what degree a similar technology shift in general is necessary for the shift from stage one to stage two (as this would suggest), or if the central feature is the evolution of the total 'absorptive capacity' in the user industry, as the general description, independent of IT, of this stage would imply. In the general description he emphasises learning effects as the initiating mechanism; the knowledge accumulated through the first stage provides the springboard for launching the quality enhancing process innovations of the second stage. To put it more bluntly; is the shift of focus from efficiency to effectivity primarily pushed by technology (in the capital goods industry) or driven by demand (in the user industry)?

The quality improvements feed demand for these services, leading to overall market growth, and to reconstitution of several services (such as 'unbundling') or service companies, as service integration or diversification, which may affect the whole industrial structure. The service industry now embarks fully on what we termed 'second order' learning effects above, where the learning organisation modifies the technology and its organisational environment and objectives. This learning process escalates the scope of the innovation, leading to progressively more radical innovation, as well as a stronger commitment to shaping technological opportunities. Systematic innovation, with an active R&D strategy, is increasingly being pursued, being based on initial activities of technology monitoring and market research (Barras 1990), particularly with software development (Miles 1987).

The outline implies that this phase is associated with a shift towards a stronger element of capital widening innovation activities; i.e., with shift away from the labour saving character of technical change in the first phase towards a neutral bias of technical change.

Phase 3: New products

With the last stage in the cycle, the effect of the new technology comes full circle in leading to the generation of new services. Barras' uses network technologies as the IT factor that facilitates this third phase; i.e., the onset of the third stage is dependent on the installation of a telecom infrastructure. Barras identifies three shifts associated with the emergence of new services; a shift

- in the locus of service delivery, from the point of production to the point of consumption,
- towards improved flexibility and improved information for customers, and
- changing service producer - service user relations.

Following the processes in the previous stage, the companies turn to increasingly more active innovation strategies, with a leading role in development of the technologies, and with a formalisation of internal innovation and R&D functions. The industry is now in a strong growth phase, where the knowledge base of the industry has now fully incorporated the technology and it is to be expected that the industry is a significant employer of relevant science and technology specialists. We may suggest that the main locus of learning in the industry has shifted from the technology to the user-producer relations; Barras expresses this as the industry having turned from initially being supplier dominated in the Pavitt sense, to becoming 'user-dominated'. It is no surprise then that the technical change processes become predominantly capital widening, and overall labour enhancing.

As a consequence of the process, the locus of innovation has now changed from the interface between the service and the capital goods industry into the service industry. The innovation strategies of the restructured service industry will therefore have stronger similarities with innovation strategies in other technology intensive industries. More particularly we would expect to see a stronger innovative effort directed at diversification of the service portfolio of the industry (trends of service product diversification are clearly visible in several service industries, see f.i. Tinnilä and Vepsäläinen 1995 for a recent review of some trends), enabled by market growth and technological opportunities, as well as a stronger incentive to interfirm collaboration and standardisation, on aspects relating to an industry 'infrastructure'. Inter-bank fund transfer and EFTPOS (electronic funds transfers at point of sale) are examples of areas with collaborative innovation, often through specific industry owned organisations.

After the reversed cycle

The outline suggests that the reverse product cycle, which evidently is a misnomer as it really is a 'reverse industry cycle', is a theory for the reactive mechanisms in

a user industry when adopting a new technology. The story told is of the service industry gradually mastering the new technology through learning effects and cumulative interactions with the services markets, finally turning the essentially reactive strategies into proactive strategies.

The role of the technological wave is central to the process; it drives the process, though based on a ongoing interaction with the development of the service industry. But as the inception of the cycle is wholly exogenously to the service industry, the question remains what happens after the wave has run its course, as evidently the initiation of a new cycle would require a new technology wave on the verge of entering the restructured service industry. Barras indicates that further development in the new services will follow a normal product cycle, with an increasing maturation of the service industry, shifting from product innovations into process innovations, innovations that as the industry shifts out of the growth phase end up as incremental efficiency enhancing process innovations. And then, he claims, "at this stage a new wave of technology may emerge within the capital goods sector, ...triggering the start of a new reverse product cycle among the now mature service industries which originated during the previous cycle" (Barras 1986).

Limitations of the RPC?

The characteristics of the process of the reverse product cycle make it an essentially Schumpeterian theory; the description has strong parallels with, and may be regarded as a detailing of certain aspects of Schumpeter's *creative gales of destruction* (Schumpeter 1934 and 1986). There is however one significant difference; the picture suggested by Barras implies a strong continuity in the industry across the cycle. Apart from (more opportunistic) integration or diversification to meet new demand structures, the survival rate in the industry would seem to be close to unity. There is not much of a destructive element.

A fact that may contribute to explain this is that two of the sectors studied by Barras are highly regulated; financial and local government services, both formally and informally[58]. This complicates the answering of one question, and an associated criticism that has been raised to the theory (Buzzachi, Colombo and Mariotti 1995); whether the process is, in the Tushman-Anderson sense (Tushman and Anderson 1986), competence enhancing or competence destroying. Based on Italian data, Buzzacchi, Colombo and Mariotti infer that the transition from the mainframe based phase, the 'mass automation' technological regime, of the 1960s and 70s, to the

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[58] Barras' study of financial services was evidently performed in the early 1980s, i.e., at a stage where the de-regulation of these services had just started. That implies that a substantial part of the history is from a phase before the implementation of de-regulative measures towards financial sectors by national governments, and well before they have had the possibilities of affecting the industry structure. But even after the de-regulation, though not based on first hand knowledge of the UK finance industry, experience from other countries suggest a rather substantial informal regulation, as shown by political initiatives to avoid bankruptcies of financial institutions towards the end of the 1980s.

decentralised ‘smart automation’ regime of the 1980s was a competence destroying transition (they call it a ‘non-evolutionary’ or ‘revolutionary’ transition, based on its effects on knowledge and skills bases, we prefer using the Tushman-Anderson terminology as this seems better suited to describe the process). The basis for their conclusion is that lags in adopting new financial services such as ATMs, home and corporate banking, are unrelated to lags in adoption of mainframe based technologies, while the Barras model suggests that the early adopters of mainframe based technologies will also lead the second wave of decentralised information systems and service diversification.

The competence destroying argument may find some support, at least when limited to financial services, in the upskilling in the industry, particularly in the IT professions, over the period, particularly in the shift from the first phases dominated by fast growing IT departments[59], with their role as ‘keepers’ of the internal databases (Fincham & al 1994). This suggests a conflict approach to the transition, where the transition has been associated with a shift in power relations between the centralised, staff based IT structures built up in the ‘mainframe’ regime and the decentralised, management based structures of the latter regime. However, based on an analysis of human resource management in Japanese banking, Baba and Takai 1990 give a more conciliatory description.

Going beyond financial services we note that Barras’ reverse product cycle is based on studies of the introduction of information technologies in service sectors, in particular to services with a considerable ‘back office’ function (Gallouj 1994), as financial services. It is an open question whether this description is equally valid for other adopting sectors, Petit 1990 state that Barras’ model is less applicable to “the development of the various self-service activities, and therefore especially to services provided to households”. Furthermore the discussion has not been extended to other technologies that are significant for services industries, such as technologies related to transport and distribution, or to health services. If this is a valid counter-argument it casts fundamental doubts on Barras’ argument of financial and business services as a vanguard of a services revolution, on par with the mechanisation of the cotton industry in the first industrial revolution.

But even supposing a more general applicability of the RPC approach in terms of sectoral and technological scope, the model is open to two criticisms. The first is related to the deterministic character of the technological influence on the development of the service industry in question. Basically the technology is treated as an exogenous phenomenon, and little is said of the purported contingent development of the technology, especially in the later phases of the cycle. We would expect the technological trajectory of the user industries to develop over time, in particular involving a reshaping of the initial technology under the influence of social and economic factors in the service industry.

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59 The establishment of large central IT departments, specialising in system analysis and development, were one of the significant organisational innovations in the finance industry to implement the back office automation related to the mainframe based systems.

Furthermore, after the cycle has run its course, the restructured industry will have attained a technological and innovative competence that makes it very unlikely that the industry would revert back to the supposed 'pre-industrial' stage from where the cycle started, to prepare for the next technological wave. On the contrary we would expect that the onset of an 'innovative paradigm' would have created options for the industry to define and develop its own (social) technology development.

We conclude that the model suggested by Barras points to many valuable features of the present development of information intensive services, but that the model is limited on three accounts,

- it has a limited sectoral and technological scope,
- the model is not a microeconomic model of innovation in services, rather it is more related to stage theories of economic development,
- finally there is doubt as to the validity of the dynamics beyond the present IT 'revolution'.

6.3 Service based approaches

The basic assumptions of service based approaches is that innovation in services is far more frequent than an 'Oslo-manual' focus on technological innovation would suggest; there are innovations where a technological approach would find none. This does not solely apply to organisational innovations - restructuring of the service producing organisation - but equally finds its application in non-technological product innovations. An indication of the frequency of non-technological innovation in services is given in Sundbo 1994c. The study of Danish financial services uncovered 84 innovations that were considered 'the most important innovations in the 1980s' through questionnaires to well informed industry observers (cfr. table 6.2). Of these, 39 were classified as technological or dependent on technology, as considered by the industry observers, while 45 were independent of technology. 15 of these non-technological innovations were organisational innovations, while 21 were categorised as product innovations. This suggests that we could expect up to the order of half the innovation universe to be independent of technology in a general sense[60]. Even though it illustrates the importance of considering non-technological innovations, it also shows that an approach to services' innovations neglecting technological dimensions also misses the mark (for a 'technology-less' approach to services, see f.i. Fourastié 1968).

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60 That is, even if they are regarded as independent of technology by the industry observers, that is by a form of informed common sense, that does not mean that the innovations necessarily are completely void of any technological content. Sundbo's example in the article of a non-technological innovation illustrates this point; a non-technological innovation may be "organisational as creating particular sales groups for example for selling by telephone". His example of telemarketing involves a use of a technological device, the telephone network, in fact it may be argued to be constituting the innovation. The defense is that the innovation is the implementation of the activity (or technique!) of telemarketing, a process where the role of the technology, though central, is completely inert.

The responses in the recent German survey of innovation in services have been analysed to classify product and process innovations according technology intensity (table 6.3). The respondents gave details of product, process and organisational innovations that were described by them as their most important innovations over the last three years. The resulting picture shows, in contrast to the structure of Danish financial services, that for all service sectors, process innovations were significantly more numerous than product innovations. The sectoral shares of product innovations vary between 30 and 40% of all innovations, with financial services having the largest share. Overall, about 75% of service innovations, including organisational innovations, had a low technology intensity. Even amongst process innovations, that according to Sundbo have the strongest technology dimension in financial services, less than 40% of the innovations have a high technology intensity in the German survey.

Table 6.2 Innovations in financial services according to technology dependency. Percent of innovation type. Source Sundbo 1994c

	Product	*Process*	*Organisational*	*Market*
Technology-independent	47	16	94	70
Technology-dependent	42	23	6	30
Technological	11	62	0	0
N=	45	13	16	10

Table 6.3 Innovation in service industries in Germany and technology intensity. Percent. Source: Licht &al 1996

	Product	Process	Organisational
Low technology intensity	79	62	-
High technology intensity	21	38	-
Share of innovation type	34	53	13

In conclusion, we should be prepared to see a variety of innovation characteristics in service industries. In the study of innovation activities in the French insurance company l'Union Assurances de Paris Gadrey and Gallouj 1994 (see also Gadrey, Gallouj and Weinstein 1995) identify eleven different types of innovations, constituting four generic categories of innovation (see below).

6.3.1 The 'peculiarities' approaches

The starting point of the service based approaches to innovation is that the 'peculiarities' of services matter; in particular the focus is strong on aspects relating

to the coproduction and immateriality of services. The attention is on ‘pure services’, that is, service functions where these characteristics are strong. Consultancy and similar knowledge intensive business services are examples. Still the approaches to innovation in services are as many-faceted as the service sector itself. Starting from the immateriality of service products and customer interaction in service production, the immediate fact that is usually stated is the impossibility of applying the ‘classical’ dichotomy of product and process innovations directly. The distinction between the two is difficult to make, and a substantial class of innovations, it is argued, fall outside these categories. More specifically, there is a site of innovations that is particularly relevant for services; the delivery, or user-producer, channel.

The resulting tripartite categorisation of services innovations into product, process and delivery innovations, has been described by Miles (see Miles 1993 and Miles & al 1995), where the potentialities and drivers for innovation may vary between the categories and between services. A distinction between three broad classes of services, whether the object of the service is physical, personal[61] or information, indicates this. By classifying different services according to broad market characteristics, table 6.4 below shows the resulting structure. Even though these divisions are only suggestive, they are nevertheless sufficiently clear to illustrate the variations to be expected in terms of innovative patterns.

As the spectrum of market structures is usually wider for intermediate producer markets than for final consumer markets, the scope for f.i. automation á la the ATM in financial services will be qualitatively different. While the doom of self service and cost disease is primarily relevant for consumer markets, this also includes services where non-technological innovations have given substantial productivity increases, as in retail trade. On the other hand, the service object dimension indicates that a diversity of trends, as technologies, will affect different service types and market channels differently. Whereas physical services of necessity have a hardware component that plays an active element in the provision of the service, this is less so for person-centred and informational services.

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[61] That the object of the service is personal means that the service modifies aspects of physical persons. This is not the same as the category of personal services in the Singelmann sense.

Table 6.4 Services production and market characteristics. Source: Miles 1995

Service object / *Market*	*Physical*	*Personal*	*Information*
State		Welfare Hospitals Health and medical Public transport	Public administration Broadcasting
Consumer	Domestic Catering Retail trade Post	Barbers Other personal transport	Entertainment
Mixed	Laundries Hotels Repairs		Real estate Telecommunications Financial services
Producer	Wholesale trade Transport and storage		Engineering services R&D services IT services Other professional services

A perusal of some of the different literature confirms the impression that most of it has producer and information services or services as 'competitive asset' as its prime concern. There is a down- and left-ward bias in the table. This may, however, be defensible through an assessment that the spectrum of change processes in this part of the table covers a significant part of the possible innovation dynamics in the whole table, or that this forms the 'most interesting' subset of the table. One such argument could evidently be for the stronger externalities that is suggested for information services.

Miles & al 1995 note that for several services, beyond knowledge intensive business services, product innovations are subject to two interrelated processes.

- With the first process of *commoditisation*, client-specific, 'craft-like' services is transformed into more general purpose services. The relevant process is the generalisation of the needs of specific customers to a functionality that meets a wider market, with a contingent development of the market channel. Evidently the process may be characterised as a codification of knowledge of more generic needs, on the basis of highly specific, and often tacit, knowledge built up in the 'craft-like' regime. An example put forward by Miles & al, is the development from custom-made, or bespoke, software to packaged software.

- In the second process of *modularisation*, service products or processes may be split up in to component elements. This may allow a form of standardisation of some of the components, and customisation may involve the combination of such standard modules (Sundbo 1994a). The standardisation may allow specialisation in production and a stronger functional division of labour. Examples of such processes are many, in transport sectors, as well as in insurance companies. This process has also shown some relevance for information generating sources.

Both of these processes have an underlying assumption of an existing or growing market. Evidently the two together form a process of 'industrialisation' of services, similar to the transformation of manufacturing industries in the late half of the 19th century. This suggests a process whereby some service sectors change into processes that are similar to processes in manufacturing sectors.

These processes will evidently not be equally valid for all services, but it suggests that the difference is more of degree than of kind, where the expression of these processes will change according to the characteristics of the service function. It is hardly likely that the same modularisation process is applicable to knowledge generating services like R&D and to transportation. One may argue that the disciplinary organisation of sciences is an example of a process of modularisation. This and a similar example from IT based system design, illustrates that associated with these processes there may arise the need to develop an 'architectural' speciality, besides the immediate division of specialities[62]. As an example let us suggest that in custom designing travel arrangements, travel agents afford this architectural knowledge.

6.3.2 Innovation in insurance

How are these processes enfolding in services, manifested in innovation processes? As already indicated a study of one single insurance company showed a considerable variety in innovation categories (Gadrey and Gallouj 1994, Gadrey, Gallouj and Weinstein 1995). The four categories may be described in the following way,

- service product innovation is the development of a new service, a service product that is new to the industry, in this case it could be the launching of an insurance policy on a new area,

- architectural innovations, as bundling or unbundling existing insurance products,

- modifying innovations, that do not affect the user's perception or the 'denomination' of the service product, but where the service product is modified from the producer's perspective. Evidently new actuarial instruments or changes in internal risk sharing belong to this category,

- innovations in processes and organisation for a service. Even though the other categories require parallel process and organisation rearrangements, they also find a class of innovation beyond this; that is, innovations leaving the final service unaltered, as improved delivery, client relations, 'fine tuning', of a service product that remains the same in its formal specifications.

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62 Even with a simple combinatorial argument, this is easy to see. With three modules, there are only four ways of combining at least two modules and one way for at least three, while increasing to five modules the numbers increase to resp. 26 and 16. If in addition the combination of modules is not straight forward, and the modules are 'complex' in some sense, the need of a design competency is soon overwhelming.

It would seem that this list has a certain 'product' flavour, that may be a reflection of the 'intrapreneur perspective' of the insurance industry; with the traditional regulation of national insurance industries, there have been insurmountable barriers to entry from other financial actors. That would lead to, it seems, a view that what in other industries would be called a capturing of a new market, is more frequently considered a new 'product'.

6.3.3 Innovation in consultancy

Turning to the business consultancy sector, this market perspective is more evident. In this sector, Gadrey, Gallouj and Weinstein, though hesitantly, classify innovations according the standard Schumpeterian distinctions, as

- product innovations, as new services based on new functions, going into a new area within the - widely defined - traditional sphere of operation, as a solicitor expanding from criminal to inheritance law, while

- process innovations include the introduction of information systems, development of methodologies and evaluation tests,

- organisational innovations, as processes in large consultancies like Arthur Anderson and Coopers and Lybrand that have led to integration of accountancy, management consulting and IT services,

- market innovations may involve the provision of existing services in new areas.

They also speculate whether the fifth of Schumpeter's innovation categories, conquering of a new source of raw materials, may be applied; suggesting the Single Market as the ground for a new legal speciality or for an expanded resource base for 'head-hunters' as a possible interpretation of this class of Schumpeterian innovations.

In addition they identify a residual category of innovations that are *specific to consultancy activities*, identifying these as 'valorising' innovations, or ad hoc innovations, cf. Gallouj, F. 1994a and 1994b. These innovations are implemented in the customer's organisation, but developed by the provider or in collaboration between the two. They represent a value added beyond the limited, contractual relationship between them, and consist of contributing new solutions to the customer's problems. The innovations are based on the service firm's accumulated stock of knowledge and experience, and may lead to the generation of new knowledge or new forms of service that from the service firm's side are transferable to new customers, depending on the 'codifiability' of the knowledge or the problem definition. Gallouj claims that these innovations are frequent in consultancy activities, but that they are not reflected in innovation analysis.

Gallouj F. 1994a notes six main characteristics of these innovations,

- the basis of the innovation process is a problem residing with a specific customer, requiring a novel solution,

- the decision to undertake a project to solve this problem is compounded with an acceptance of the consultancy's mission, suggesting a leading role for the consultancy,
- the process is 'non-programmed', with recourse to a more or less formalised structure of expertise,
- there is no 'prototyping' in an ordinary sense; the first implementation of the innovation in the customer's organisation is full scale,
- the commercial objective of the project is 'up-stream', rather than 'down-stream'; the innovation is contracted before it exists, before its characteristics are known,
- a new (post-)innovation phase emerges, residing exclusively with the consultancy; a phase of formalising, or generalising, the innovative solution.

Evidently this form of innovation concerns complementary learning processes for both the producer and the user. In that sense they seem to have a lot in common with Lundvall's concept of learning-by-interacting, and the contingent process towards organised market relations. The characteristic of the consultancy-client relation is that many of the ordinary barriers to information flows between the two are voluntarily suspended or reduced, at least for a limited time,[63] implying the role played by trust. In this, they are in accord with a larger class of potentially durable and selective user-producer relations (Lundvall 1992b).

From the perspective of the consultancy, the innovation 'proper' would probably be assessed as being located, at least partly, in the post-innovation phase; the codification of the acquired experience and an accompanying reorganisation of the existing knowledge base that allow a generalisation to other customer categories. This 'reification' of the experience may be easier in some services than in others, depending on whether the service provision involves the codification explicitly, as in solving a legal problem, or not, as in management consultancy. From this perspective the consultancy process is a learning process enabling or facilitating the innovation.

For the client to the consultancy, the implementation of the 'valorising' innovation probably requires strategic decision making by the client, decisions that will affect his or her future performance; whether it is a new computer system design, establishment of a new product line or a reorganisation of the business. We presume

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63 The consultancy-as-producer may be a one-off 'supplier', but there are other situations where the two are involved in longer term relations. In both cases, mutual trust is important; the consultancy will many times acquire confidential information about the client(and is required to acquire this to give adequate advice). Though we have not looked into empirical evidence on this, this suggests a hypothesis of a growing share of long standing relations, and a positive relation between the clients assessment of the quality of the service, evidently measured by its effect on the clients performance, and the duration of the relation. The reason for this is simply that the development of a common 'mind set' (Phillips 1994) or communication code (Lundvall 1992b) that enable effective information exchange between the two parts is a costly process, a capital fund that is intimately tied to this relation. The vitality of trust in the relation is thus not specific to services like consulting activities, but equally apply to other producer-user relations.

he or she would characterise it as their ‘own’ innovation, though strongly aided by the consultant.

But both these aspects of the innovations are contingent upon the highly specific relation between the service company and its client. We suggest that the term ‘induced innovation’ be used to cover the wider class of innovation processes of which the valorising innovations are a part; innovations being generated in a close problem solving relation between producer and user. As noted by Bilderbeek & al 1994, innovation networks, relatively stable configurations of firms, personnel and professionals, may develop on the basis of these relations. These networks will have a potentially substantial impact on the innovative performance on the firms in the network.

Nevertheless we conclude that the identification of this category of ‘valorising’ innovations is extremely valuable. They point towards the interactive relationship between these kind of services and their customers in other economic sectors; that is towards services in innovation. Furthermore, as argued above, they seem to be well adapted to extension to the concept of innovation systems. On this basis we would suggest that this class of induced innovation processes is much more general than the restriction to consultancy suggest.

6.3.4 Servuction

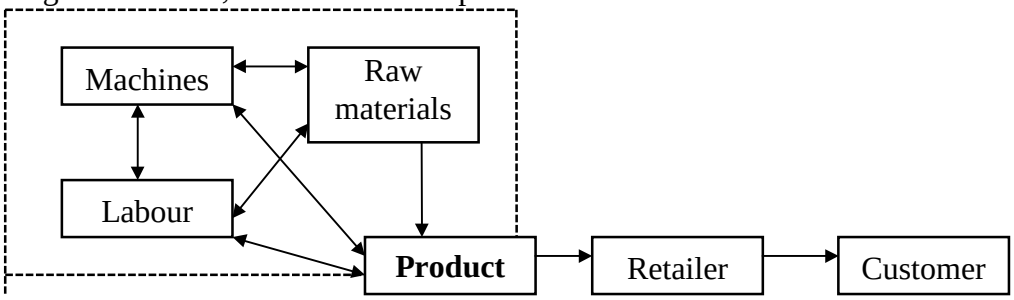
A representative of what may be termed the most extreme view of services innovation is the ‘servuction’ approach of Eiglier and Langeard (Eiglier and Langeard 1987). The fundamental elements of the *serv*ice prod*uction* - the ‘servuction’ process - involve the client, or customer, as opposed to the production of tangible goods, cf. figure 6.1. The integration of the customer as the defining element implies that an externalisation, a ‘tangibilisation’, of the service is difficult to envisage, without having the service changing character. The customisation is evidently an integral part of the production of the service, in fact it is indistinguishable from the service itself.

The integration between producer and customer implies that ‘innovation’ in this context must necessarily involve the tacit and idiosyncratic social relations between the two; innovations will be extremely complicated, involving the two partners in a interdependent relationship. That is, innovation would be a bi-lateral phenomenon, and were the process for the service provider to transfer these local innovations to other customer relations will be difficult.

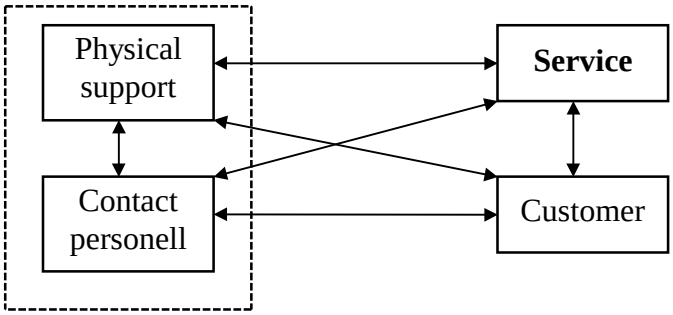
It is emphasised that no service firm offers only one service, but that the provision consists of a set of complementary services, just as all ‘three star’ hotels in France offer an ensemble of services like restaurants, bars, swimming pools, etc. They propose that this permits distinction between one base service, and several peripheral services. The base service is defined through its role as constituting the business of the service firm, or in their ‘servuction’ framework, the service that satisfies the basic need of the customer, whereas the rest is peripheral services.

By approaching innovation from the perspective of developing new services, they get two broad classes of innovations,

- new services, which mainly involves the introduction of a new base service on the market, representing 'radical' innovations, and
- extensions of existing services, that is the adjunction of new peripheral services to the existing base service; this would correspond to 'incremental' innovations.



a) Manufacturing production



b) Service production

Figure 6.1 Production and 'servuction'. Source: Eiglier and Langeard 1987

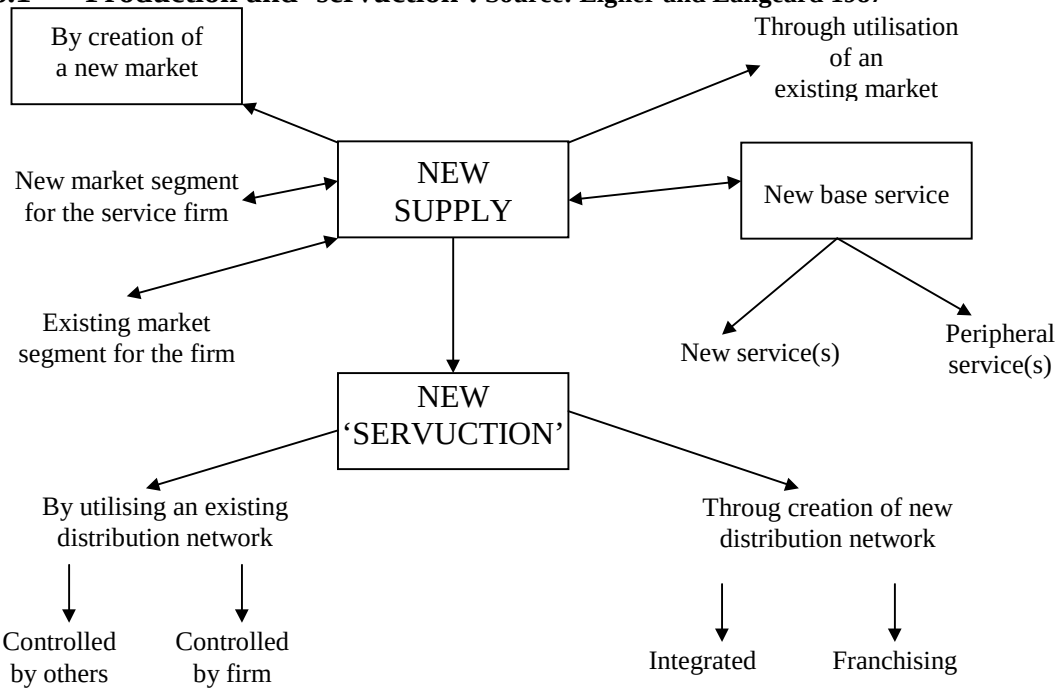


Figure 6.2 New services in the 'servuction' approach. Source: Eiglier and Langeard 1987

Evidently there is also a class of innovations of removing peripheral services, f.i. as a strategy of standardisation or cost-cutting. Eiglier and Langeard consider innovations, new or enhanced services, from a managerial perspective; that is as new to the firm. The list of possible innovations have a strong 'service product' flavour. One may consider why they seemingly do not consider 'process' innovations, but they do. For these authors the introduction of changed services, through the integration of the customer in the 'servuction' process, involve the 'supply system', the 'servuction' system and 'image management'. A change in aspects of these, also corresponding to 'servuction process' innovations is considered as changed services, and thereby falling into one of the three categories.

The resulting mapping of the innovation landscape is shown in figure 6.2. As suggested the approach leads to a complicated view of innovation. With the definition of 'servuction', the upper part of the figure may be interpreted as product innovations, while the lower part would then *correspond to process innovations.

6.3.5 Stagnant services

As the previous approach to services, Baumol's 'cost disease'[64] (Baumol 1967 and 1985, Baumol, Blackman and Wolff 1985 and 1989) approach is not formally an innovation theory for services. Rather it could be termed a (technological) productivity theory, specific conditions for provision of certain services is reflected in their role as productivity laggards.

The service sectors' share of total output in 'real' terms does not reflect the growth and dominance of the sectors in the share of employment and output in current values, i.e., if national output statistics expressed in current denominations are compared to the same statistics denominated in 'constant prices', the growth of service sectors is substantially reduced, or may even vanish. The relative growth of service sectors in current GDP may be substituted with a constant share of 'real' GDP. If the valuation in 'real' terms closely enough describe output in 'volume' terms, this would imply the existence of significant productivity differentials between service sectors and manufacturing industries. The gap between current and real valuations of the service share reflects a change in (unit) prices of services relative to other sectors of the economy in the period from the base year. A positive difference between current- and real-valued growth rates of the service share implies a tendency for services to become relatively more expensive; the productivity of other sectors increases faster than productivity increases for services.

As we saw in chapter 1 such productivity growth differentials show up between manufacturing and service sectors; the productivity growth is consistently higher in

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64 The identification of the 'cost disease' property of stagnant service sectors is deservedly attributed to William Baumol, though the principle behind was well known before 1967. Even with constant relative demand for these services, relatively slower productivity growth will require an increasing share of employment in the sectors. From this it is a small step to conclude on the development of relative prices. Baumol's general equilibrium argument gave a simple model to illustrate the phenomenon and its consequences; he gave the phenomenon 'a face'.

manufacturing than in services, as indicated by figure 1.4. The productivity increases show up as some combination of reduced unit prices of the output, and increased compensation to input factors, in this case more specifically, labour. If labour markets are shared, or with sufficient mutual influences, between a high- and a low-productivity growth sector, the wage rates in the two sectors will be positively correlated. One sector will then probably dominate the determination of the wage rates; the development of the wage rate will then reflect the productivity growth in dominant sector, and not in the other. In the case of the wage rate being determined in manufacturing sectors, this will incur a growth of the wage rate in the service sectors. The spillover mechanism transmitted by the labour markets will inflict cost disease on these sectors.

In the Baumolian framework, this is accounted for by classifying services in three broad categories; stagnant (personal) services, progressive (impersonal) services and asymptotically stagnant (impersonal) services. Though the categorical classification of services in the two extremes has softened since the original formulation in 1967[65], also with the addition of the intermediate category of asymptotically stagnant services, it is a major weakness of the approach that the distinction of services in the various categories is not done on the basis of the 'peculiarities' of the different services. Rather the distinction is made, in an almost self-confirmatory way, *post hoc* on the basis of each service sector's productivity record.

What distinguishes the three sectors is the long run opportunities for productivity growth, based on their properties as regards client intensity and possibilities for standardisation.

- Stagnant services, with client- and labour-intensity being high, resist productivity increases of the traditional kind, as standardisation automatically triggers a decrease in service quality. This, leading to the 'cost disease' phenomenon where the service will eventually either price itself out of the market or degrade in quality, increases the substitutability of services for households' capital goods. These services conform with the supplier dominated picture of innovation in services; the possible source of productivity change in the stagnant services is imported or induced technological change. The change affects primarily the physical support of the service provision, but it may also create opportunities for expanded services, such as the broadcasting of a Mozart string quartet. Thus, exempting these exogenously driven phenomena, the 'cost disease ' demise of the stagnant sectors is inevitable as long as there are progressive sectors around.

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65 In particular compare Baumol 1967 and Baumol, Blackman and Wolff 1985. In 1967 Baumol stated that with "an arbitrarily chosen dividing line ... one can fit all goods and services into" two categories, but his assertion was much stronger than this; the characterisation of any particular activity as stagnant or progressive "is not primarily a fortuitous matter determined by the particulars of its history, but rather that it is a manifestation of the activity's technological structure". In 1985 they emphasise that "the model is obviously a gross oversimplification ... an activity which is *relatively* stagnant need not stay so forever[;] things must go as predicted only as long as there is no major qualitative change in the distribution of innovation among industries".

- Progressive service sectors produce services where the scope for productivity increases is no different from manufacturing sectors, and with low client-intensity. These services are technology intensive, with productivity change being driven by changes in the technologies underlying the services. Evidently this classification of services as progressive requires a fairly stringent idea of 'disembodiment' of the services; the service production is technology based, even technology constituted. A service produced in a progressive sector will avoid the 'cost disease', through its relative price fall that is induced by its technological development. Hence the progressive sectors constitute the innovative service sectors, in two senses. Firstly in the restricted sense of intra-industrial productivity enhancing innovation, secondly in the wider sense of continual technological innovation generating new services, while innovation in stagnant sectors is sporadic.

- An asymptotically stagnant activity is defined by its use of two groups of inputs; one originating in progressive, the other in stagnant, activities, and where the stagnant input cannot be (entirely) rationalised away[66]. Even though these services may show a progressive productivity development in the short run, the long run behaviour of these services will evidently be governed by the stagnant inputs; the stagnant part "carries the seeds of [the service activity's] destruction" (Baumol, Blackman and Wolff 1985). Evidently the criteria behind this category are different from the ones behind the stagnant/progressive distinction, when this is based on productivity records and not on features of the services involved. The characterisation as asymptotically stagnant describes the expected future behaviour of the service activity; i.e., it is a 'first-order' distinction of the 'zeroth-order' progressive activities (or possibly a similar distinction of stagnant activities in terms of past development).

On the basis of several measures of productivity change in the US over the period 1947-1976, the service sectors that are classified as stagnant include

- finance and insurance,
- hotels,
- medical and educational services,
- government enterprises.

Trade, transportation and communication, as well as the class of business and professional services, end up in the 'zeroth-order' approximation of progressive activities. The distinction between asymptotically stagnant and progressive activities on the basis of productivity records is, as already, noted difficult to make, but the authors give broadcasting and computer services as examples of asymptotically stagnant services.

Evidently this classification and the innovation trajectories it implies is crude. The doubt as to its applicability is reinforced by three factors, even when disregarding the

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66 The simplified assumption is evidently that it is a fixed proportions activity; the share of stagnant input is constant.

obvious point of the reliability of the volume data that underlie the classification[67]. First it is essentially a taxonomy of existing service activities; it has no strength in terms of describing structural change and the development of new service activities. Secondly the scheme neglects to give organisational changes in the provision of services any significant role. Thirdly, the data are probably significantly affected by the chosen time window. While trade sectors are included in the progressive sectors (which in itself is at least partially explained by non-technological factors), financial services are classified as stagnant. We suspect that the classification would change if it was expanded to include a post-1976 period.

A dramatic example of the changes that may be missed is given by the development of transportation in the nineteenth century. As described by Michie 1994, the introduction of railways to supplant road transport led to a substantial decrease in transportation rates. The price gap between the two increased significantly as rail transport increased in efficiency. In 1859 rail freight rates were 20% of wagon rates in the US. By 1890 rail cost only 6% of road transport, with an increase also in delivery abilities through greater independence of weather conditions. This suggests the warning we issued in the introductory chapters, of distinguishing between the services *rendered* and services *produced*.

The role of service functions integrated in manufacturing production, as well as of intermediate services is left unanswered. When up to 75% of costs related to manufacturing production are service costs (cf. Quinn 1992) and maybe 8 out of 10 employees perform service functions (Larsen 1996), the cost disease would seem to apply to manufacturing production as well. In the presence of an industry cycle type development (Abernaty and Utterback 1978), even if the productivity increases may outrun the cost disease in the first phases, inevitably the demise will be fatal. The rejuvenation of the productivity growth comes with a technological restructuring of the industry; a shifting of ‘technological trajectory’ (on technological paradigms and

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67 Evidently the group of stagnant activities include most, if not all, sectors where the problems of output measurements are most severe, see f.i. Griliches 1992. The measurement problem of real output in service sectors implies that more than half of the economic activity in industrialised economies is in sectors that are ‘unmeasurable’; extending the argument of Griliches 1994 to other countries.

This raises two questions, whether the growth of services, and hence of in some sense mismeasured productivity growth can explain away the post 1973 productivity slump, the socalled ‘productivity paradox’ and if the variations in standards for real output measurements for individual industries between countries may lead to distortions that reduce international comparability of productivity and related data. Gordon 1996 argues convincingly that the first question must be answered in the negative; it is difficult to see how the productivity mismeasurement could lead to a rapid shift in productivity growth levels within the span of a few years in the mid-70s.

However, as to the second question, it is worth considering to what extent differences in sectoral productivity growth rates, as they are evidenced by national public statistics, may be explained by the use of different measurement techniques. But even in the case of identical measurements, it is evident that aggregate productivity mismeasurement will have a structural dependency, determined by the structural composition of the country in question and the variation in mismeasurements between sectors or industries.

trajectories, Dosi 1982 and 1988, for a recent review of the discussion of these issues, see Freeman 1994), or a replacement of the industry in question with a new one. Before this happens, the 'mature' manufacturing industry would be exposed to the same mechanisms as stagnant services. The similarities between services and manufacturing might be presented in a way that emphasised the similarities, rather than the differences.

This is in principle at least an empirically verifiable proposition. An analysis of cost structures and output prices of mature industries would reveal whether this was the case. However, the consequence of this argument is that in most countries, almost all economic activity could seem to be in stagnant sectors, so we are left in doubt as to the force of the argument as to relative developments between economic sectors.

Nevertheless the argument describes the effects of important aspects of the service/manufacturing interface, at least in the short run. It also contributes to explain why hairdressers in Europe earn substantially more than hairdressers in India. Examples like the development of transportation, however, illustrate that the argument should be used with caution in the long run, where the probability of changes that may displace former industries is greater, both for services and for manufacturing, i.e., it is not able to describe processes of a long term structural change of modern economies.

6.4 Integrated approaches

As mentioned in the introduction to this chapter, these approaches have common objectives of developing a framework that enables a unified discussion and analysis of economic change, bridging the dichotomous gap between material goods and services. Few of the approaches to the growth of services in this category involve a specific focus on innovation in services. Rather they can be characterised as 'grand theorising' on the issue, with implications for innovation dynamics in service sectors. Most prominent among these approaches are those that attempt to analyse the aggregate features of the 'service economy', linking it to micro-economic data that include both demand and supply side factors, as a basis for interpreting the interdependencies between different sectors to allow inferences to be drawn on the future development of the overall 'service economy'. This includes early attempts, like Fisher 1935 and Clark 1957, and is explicit with Gershuny 1978 and Gershuny and Miles 1983. The prospective objectives are weaker with writers like Fuchs 1968 and Stanback 1979, as they are with a recent contribution such as Daniels 1993.

The divergence of two lines in the literatures, dividing between the 'neo-industrial' approaches, like Gershuny 1978, emphasising complementarities 'over space', and the 'post-industrial' literatures, the 'classic' reference being Bell 1973, with continuity over time, has led to two contrasting views of the future societal development. The role of expertise and knowledge in the post-industrial society would suggest an increased role for innovation in the 'post-industrial' service sectors. But the concept of innovation is difficult to find, and when it is visible, it takes a quite naïve form. One could either argue that the knowledge intensity would make innovation into a permanent state of affairs; knowledge creation and utilisation being the 'axial principle' of these societies (Bell 1973), or that at least the Bell version of

the society is a society where the ability to plan is extensive; the extent to which social and physical life will be greatly increased. Alternatively it may be said that the post-industrial society is a 'sociologising', rather than an 'economising', society (Bell 1973, Gershuny 1978).

For Gershuny 1978 and Stanback 1979, the interdependencies between manufacturing and service production forms an essential foundation for their analysis. The complementarities between manufacturing and services include

- the dual relation between consumer goods and services, as between increased consumption of automobiles and increases in related services,
- increases in the scale and scope of use of producer services by manufacturing companies, and in the mutual intensity of these relations, and
- the 'post'-Engelian argument leading to the 'self-service' or 'do-it-yourself' trends of substituting (capital) goods for services; Gershuny shows that the longitudinal (over time) trend is a reduction in the services' share of expenditure, rather than the Engelian increase that is shown in cross sectional data at an instant in time.

What the integrated approaches share is the conviction that tangible products and services share important characteristics; the dichotomous dividing line is dissolved and replaced by a continuum, extending from 'pure goods' to 'pure services'. For substantial parts of the tangible part of the spectrum; the core of the manufacturing industries, the service dimension to these goods is often considerable. In the management and corporate strategy literature this is illustrated by the abundant literature on service dimensions to manufacturing production, of service driven competition.

The manufacturing company is then envisaged in an internal and external landscape of services, see f.i. Quinn 1992, chapter 6, with services, often hidden as overhead costs, representing the largest cost item of all. The lesson to be drawn from this is the importance of complementarity approaches like these above; tangible and intangible goods are substitutable, as well as complementary. What is important is what needs they satisfy, not how they do it.[68] The distinction between a service and a manufacturing company dissolves, as does the distinction between innovation in services and innovation in manufacturing (as long as the focus is restricted to the services integrated into the 'service-manufacturing' complex). As noted by Gallouj, F 1994a this has two consequences. Firstly, this allows an approach to innovation in services by analysing the service dimension of manufacturing innovation, and their associated service functions. This could suggest that the innovation literature on services is richer than has been suggested, but just as the service literature is thin, the innovation literature on the service dimensions of manufacturing is equally sparse.

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[68] The ultimate expression of this is Levitt's comment that quarter-inch drill bits are sold in millions, "not because people want quarter-inch drill bits, but because they want quarter-inch holes. People don't buy products, they buy expectations of future benefits" (Levitt 1969, as cited in Quinn 1992)

Secondly, the role of complementary assets (Teece 1986) is enhanced. With an increased role of the service dimension as an competitive asset, so will the associated complementary competencies play a decisive role in allowing companies to appropriate the benefits from innovations.

An innovation theory for the self-service society, based on the Gershuny approach, is sketched in Gershuny and Miles 1983. Central in this is the concept of 'social innovations'; innovative changes in consumers' lifestyles and consumption patterns, changes that are induced by new consumption possibilities that may be due to innovative products. These are changes in social behaviour and patterns wrought by the proliferation of instruments like the automobile, the telephone, household durables like the washing machine, etc. Evidently this class of social innovations must be considered as closely related to the ideas behind the literatures on social shaping/construction of technology (see f.i. Bijker 1995); the integrated development of a product and the social environment in which it is used and given meaning; *viz.* in a socio-technical system.

A more heuristic approach to innovation is offered by Belleflamme, Houard, Michaux and Ruyssen 1986. They note that the necessary and sufficient conditions for producing a good may be expressed as composed of different elements and processes; the material inputs and conditions for production, the means for customisation of the product; i.e. the 'servuction' process, and the organisation and management of the firm. If the material part dominates, the product would be 'material', if the servuction part dominates, it would correspond to a service. Then it is possible to distinguish three classes of innovation; introduction of new products, changes in production processes and 'servuction' processes, or combinations of these. In addition there are organisational innovations, either autonomously or in conjunction with the other.

Barcet, Bonamy and Mayere 1987 suggest a distinction between three classes of innovations; 'functional innovations', 'innovation by specification' and 'production innovations'. Functional innovations correspond to the development of (concepts) of new functions, still being abstract. A suggested example for service sectors is a strategic decision to reorient a consultancy towards f.i. risk management (Gallouj, F 1994). The specifying innovations (*innovations de spécification*) consists of the differentiation and concrete development of functional innovations into product or service offers that are distinguished from those of competitors. This may involve a differentiation in terms of market segments or individual customers. While functional innovations are weakly appropriable, the specifying innovations are easier to appropriate. The division between the two, that suggests a division within what is usually considered as one innovation process, suggests that there is a complementarity between the two, also in terms of appropriation. The last class of innovations, production innovations, includes what are usually termed process innovations. They are aimed at maximising opportunities for standardisation, usually based on the application of technical means. For service functions they reflect what we referred to as 'back office' functions.

These categories still reflect the ambiguities in the distinctions between process, product and delivery innovations. Furthermore the division between functional and specifying innovations would be extremely difficult to operationalise in practice. Its

main advantage is as an attempt to develop a terminology that allows a uniform approach to innovation for both service and manufacturing functions.

7 Innovation in services

In the preceding chapters we have described a wide range of issues pertaining to innovation in services. In this concluding chapter we want to point briefly to the main conclusions that this allows us to draw.

First, there is a significant innovation activity in services. As statistical instruments are refined, the documentation of aspects of these activities indicates that the level of innovative activity in several service sectors does not fall significantly behind the level in other economic activities. This is reassuring, in that features of competition that are reflected in innovative activities are at work also in service sectors.

It is, however, important to keep in mind the strong heterogeneities between different service activities in terms of their activities. Remembering that the concept of services is based on the conception of a residual, this comes as no surprise, but it is a fact that is often neglected in the relevant discourses. That raises the difficult question of what the criteria behind a new taxonomy should be, a question that is probably dependent on the context in which the discourse is raised.

We have seen that some service sectors are significant receptors of higher educated personell, even when restricting the focus to market based activities. But the evidence also shows that the distribution is highly skewed, just as in manufacturing. The process of 'upskilling' of the work force in OECD countries is to a large extent constituted by a significant structural shift of employment, within manufacturing and services and between them.

At the same time there has probably also been a substantial growth in service R&D expenditures, even though this is difficult to discern from the growth that is generated by increasing statistical coverage. It is striking to what degree the growth of R&D expenditures and 'upskilling' are correlated at sectoral level, even though the existence of the correlation is expected. Roughly the same development may be seen in manufacturing sectors.

It may also be seen that these 'growth poles' are related across boundaries between 'grand sectors'. That opens up for two conclusions. Firstly it indicates that the categories we use to distinguish different activities misses important aspects of the developments. Secondly, these 'growth poles' also include sectors that have the most wide ranging relations to other productive sectors. That leads us to expect that change processes in these sectors may have indirect impacts well beyond the direct relations between the sectors.

The conclusion we will draw on the basis of this is that to understand services, we need to understand 'interactive innovation', or innovation in networks. This may be regarded as stressing elements that is central to the innovation system literatures. Still, much of this literature has one important short-coming. The idea of innovation systems, with its emphasis of interactive learning, has done much to shift the debate about innovation and change away from a sole focus on embodied technology, science based activities and codified knowledge. But the understanding of the elusive concept of tacit knowledge and the relation between these knowledges and

organisational development, is still fragmentary. The shift of focus away from freely available codified knowledge opens up a panorama of strategies to appropriate knowledge, both for internal and for commercial purposes. Increased focus on these processes leads to the need of a better understanding of learning processes and knowledge development, and a better classification of knowledge than the simple codified/tacit dichotomy. For one attempt in this direction, see Faulkner and Senker 1995. Doing this leads to the paradox that innovation systems may then become indistinguishable from general production systems, the innovation systems are dissolved into the wider structures or systems that make up the production structures.[69]

This development may come a long way towards contributing to an explanation of the 'complexification' of production structures, and hence also of the 'externalisation' issue. It may seem that the network conclusion is just a shift back to a manufacturing based structure, including the relevant services in manufacturing 'clusters'. This is from our point of view wrong, the network innovation issue is also recognisable in manufacturing industries, the increased role of technological collaboration and joint ventures is well acknowledged for innovation intensive manufacturing sectors, see f.i. Hagedorn 1994, as well as network based literatures as Lundgren 1995. The argument is that the interactive element is fundamental to understanding innovation processes everywhere, irrespective of 'grand sectors'. If one should raise the question if not the *primum mobile* still resides in the manufacturing sectors, the evidence is mixed. As with the industrial revolution, the question of what is the first mover is open. Even though we can cite examples where service industries seems to play a first mover role, like in the tourist cluster in Greece, and maritime transport in Norway, there is no clear evidence for any bastant conclusions.

On the other hand, there is considerable scope for 'peculiarities' of services to affect how different service functions and sectors change. But allowing these peculiarities to play a distinguishing role for all of services is probably wrong. Whereas personal services may be more amenable to being affected by these 'peculiarities', knowledge intensive services like consulting and engineering develop schemes allowing the development of proprietary knowledge.

Hence we will expect that characteristics vary quite considerably between different service sectors, and the available empirical evidence confirms this. However, one aspect seems to be fairly valid across a wide range of service sectors, the informality of organisation of innovative activities. This may be explicable in terms of service peculiarities such as customer intensity. We cannot at this point say conclusively if this changing, but there are signals of increased formalisation in some sectors, particular the 'innovation intense' sectors. We must note that this focus on informal innovation processes, and particular as regards R&D processes, has come at a time when the focus of short comings in the general methodology og R&D surveys have become more focused.

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69 We are indebted to Bengt-Åke Lundvall for this point.

The evidence also shows that information and communication technologies play a substantial role in the enfolding dynamics. The data on the structure of capital stocks indicate that one of the most profpund changes that have happened over the last decades in the proliferation of IT investments. This is also a relation that goes beyond the direct interactive elements that were indicated above; the growth of IT related capital stocks is a more general characteristic. Even though a substantial part of this in services is of 'computing facility' type, whether towards centralised or decentralised intra-firm information structures, three other developments point to other aspects also being of relevance for service sectors. First we point to the development of ICT infrastructures, and concomitantly, the development of a wide range of ICT services. Secondly the developments of medicalø technologies have changed medical services. Lastly several transportation sectors incresingly focus new IT based technologies for a wide range of services, such as tracking and supervision, satelite navigation and digitalisation of maps.

III Services in systems

Introduction

"The development of business services is not
an independent occurrence unconnected with changes in industry …
[Service] inputs have a specific role because
they are an essential vector carrying the
intelligence, information, technologies and innovations
which are permanently needed …"
Business services in the European Community: Situation and role
Commission of the European Community, 1990

History is strewn with paradoxes. The lack of attention to service industries in industrial policies and analysis seem to be two of these. If the preceding section II tells something close to the truth, the tertiary sectors of modern societies emerge as significant parts of the overall economic landscape.

There are two possibilities of broad approaches to the service dimension of economic development and innovative performance in modern societies. The first we may term a dichotomous, or dyadic, approach, regarding two or more sectors as totally separated or only weakly interacting. It may be extended to include an assumption of independence between two categories of final demand; the changes in demand for 'non-goods' being little impacted by changes in 'goods' demand. Such an approach opens up for regarding innovation processes as fairly segregated activities across the borders between the sectors; innovation in services and innovation in manufacturing may be regarded as reasonably autonomous processes in terms of their inner logic. If the characteristics or 'peculiarities' of these respective sectors differ significantly, these inner logics may develop along quite independent trajectories; intra-industrial factors may then dominate inter-industrial linkages. When analyses of innovation in manufacturing industries are treated as general innovation analyses, they are of this kind. To the extent that service functions are considered as contributing to innovation processes, they often include only the effects of service functions that are direct inputs into innovation processes.

The second approach is more aptly characterised as a 'systemic' or complementarity based approach. The starting point of this approach is that what are termed different economic sectors or industries are interlinked in complementary and 'systemic' relations, economically and socially. This web of interlinkages has a decisive impact on the development of each individual industry. In contrast to the former approach inter-industrial linkages will lead to dependencies between innovation logics.

Whichever approach is chosen to a bilateral division between services and manufacturing, widely interpreted, the fact that service sectors account for a considerable share of total employment implies that they also employ a significant share of productive resources in these economies. Hence their sheer size alone leads to considerations of their impact on both equity and competitiveness. The large sectors will dominate aggregate productivity development, and hence national economic development. As long as the sectors are treated as completely separated, in all respects, the effects of the Baumolian cost disease must run their course.

But even with the first approach, there are still relations between sectors that may prove important for the development of each one individually. First let us consider the availability of factors of production. As long as factor markets are shared among the sectors, the allocation of productive resources among different industries will have an impact on the development of all industries. The structure of capital and labour markets in the Baumol model may be an example of completely mobile factors. The service sectors use of productive resources will have a direct, negative effect on the development of manufacturing sectors, and thereby creating substantial opportunity costs. This is especially relevant if there is a large productivity gap between the sectors. The distribution of qualified scientists and engineers may be a suitable example. If service sectors are productivity laggards, the present allocation of these resources may be seriously non-optimal; there may be substantial opportunity costs attached to the present distribution. That productivity laggards employ a considerable share of these resources at the expense of productivity vanguards creates a structurally compounded gap towards potential productivity increases.

There are several reasons why this gap may be argued to be un-viable, as market rigidities and differences in trade patterns between the sectors. But structures such as these are not enough to disallow the potential opportunity costs becoming real. The simplest way to see this, is to note that sectors are not just bordered by factor markets. Even with complete economic separation between the sectors beyond factor markets, we have to consider additional cross-border influences. On the opposite side of factor markets, final markets will also involve cross-sectoral linkages.

To keep the structure simple, we will start with the assumption that demand patterns fall into two separate categories corresponding to the division between the two sectors, a stagnant and a progressive sector. The mobility of labour between sectors bids up the wage rate in the stagnant sector to the level in the progressive sector. This leads directly to the predicament of the cost disease model; the ‘stagnant’ unit price rises beyond any limits as the wage rate, or unit cost, does not reflect the slower productivity growth in this sector. In ‘normal’ situations the growth of the stagnant sector would probably soon be undermined; the increased relative price should be expected to lead to a rapidly falling demand, whether the increasing relative price is realised through higher actual prices or reduced quality.

If stagnant sectors were characterised by higher income elasticity initially, it is reasonable to expect that in the long run this elasticity would be reduced below the income elasticity of products from the progressive sectors, demand growth leaning more towards progressive sectors (this is essentially the Gershuny story).

Substitutability between the two kinds of products will probably accelerate this process. Furthermore, the existence of possibilities for substituting consumption of 'stagnant' services with consumption of 'progressive' products forms an incentive to new products that substitute for former services; innovation in the progressive sectors will be shaped by characteristics of the stagnant sectors to a considerable degree.

Even with a conception of services as supplier dominated innovators, interpreted as entailing a one-way relation with the suppliers, the sectors are treated as essentially independent. With the description of section II as a background, these associations are far from uni-directional, linear relations. This opens up the wide panorama of extended relations between manufacturing and service industries, between 'goods' and 'non-goods' sectors, and within each of them. The different sectors participate in widely spread networks, in 'systems', of interaction, where the character of interaction is varied. Partly the interaction is economic, or pecuniary, that is mediated through market mechanisms; mediated by factor and intermediary markets, by capital goods markets or product markets etc. Partly the interactions include wider social interactions, as with inter-firm mobility of personell, and the associated mobility of experience-based skills, and with inter-firm learning that is generated by social, economic or otherwise, .

This shifts the emphasis from the first dyadic to the second systemic approach outlined above. The interactive relations between manufacturing and some service industries have always been acknowledged, as we saw in John Stuart Mill's classification of productive activities. The characterisation of services as un-productive or as productivity laggards is understood as referring to only a subset of service activities. Service functions that overwhelmingly function as intermediate production in a chain of material production are set apart; they derive their productivity from the production chain in which they participate. In this sense there has always been a service dimension to industrial and innovation policies, but this perspective seems to have been redefined into an industry structured policy approach.

The recognition of many-facetted interlinkages between economic sectors, is what raises the need for a 'systemic' approach, recognising that inter-industrial linkages may prove decisive for the development of each sector in the interacting web. The web of economic interactions is embedded in wider social structures, shaping behaviour by individual agents (on embeddedness of economic behaviour, see Granovetter 1985, see also Grabher 1993) and the development of different (sub-) systems. The development of concepts such as systems, complexes or clusters may be read as a search for developing alternative units of analyses to the traditional separation into different single-line industries.

The development of present-day economies is shaped by such interactions; it is impossible to envisage one industry or sector without at the same time recognising several others. Their economic performance, their technology use and innovation performance are all shaped by the relations to other sectors. For service sectors this is most evident in the case of service sectors that are strongly integrated with other economic sectors, as services that are primarily provided to other business sectors. Evidently this also implies that innovation processes in service, as well as non-service, sectors cannot be understood solely as local phenomena limited to each industry or sector.

Our objective with this third part is to outline some ideas reflecting this wider focus. The project framework of this report has not allowed us to do otherwise than raise some issues, in a purely indicative sense. The issues that are raised here are evidently important for understanding economic change; and they will form a central part of our future research agenda for the coming two years.

The questions we raise can be phrased as follows. What roles do service functions play towards innovation processes in general? This raises important questions on how we conceptualise the different aspects of the interactions between the service functions and the innovation processes. We will not attempt to develop a complex innovation theory; we feel this is far too premature given the present state of our understanding of economic dynamics and innovation. Rather we will take a more modest approach of describing some aspects that seems to be relevant.

In chapter 8 we will describe some of the interactions between industries and discuss the role of some services towards other industries. The following chapter will outline two issues; a possible convergence of several service and manufacturing industries in terms of characteristics of innovation processes, and a discussion of the role of ‘knowledge-intensity’ in services. The last chapter will outline some issues relating to the role of services in learning-based innovation systems.

8 Services - economic interactions

We have seen that the OECD countries have been characterised by marked structural changes over the last two decades. Service sectors have participated in these changes, as shown for instance by employment data, as seen in figure 1.1. In spite of a 60 year period of trying to answer the question, it is however still unclear what role different categories of services have played in these transformations and what the localisation of the growth of different service activities is in the enfolding processes. What seems certain is that there is no single factor behind the change processes; rather it seems that the pattern that emerges when we observe aggregate structural characteristics of these economies is a consequence of a wide range of interacting and inter-dependent factors and processes.

Demand factors have definitely played a decisive role and will continue to do so over the next decades. The demographic changes associated with the aging of the 'baby-boom' generations, together with increased public health, shifts the age structure upwards. This in itself shifts demands for particular services and commodities. As the 'baby-boom' generations grow older, the capital structure of the household sector will change; their higher income levels over their working life compared to previous generations imply that they will shift more rapidly from net borrowers to net holders of capital, and to achieve higher levels of capital assets than their parents. Together with demographic structures this enfolds as a rapidly changing financial position, purchasing power and demand patterns of the household sector.

The increase in the employment of QSEs, cf. chapter 4, contributes probably to an intensification of a 'technological' (non-pecuniary, see Papandreou 1994) competition in consumer markets, augmenting competition in capital and intermediate markets. On the other hand, this story also has a supply-side dimension; the shaping of technology, increased technological competition and higher innovation rates, modulated by the educational upgrading of the work force, changes competitive features of services and commodities and ultimately shapes the supply on consumer markets.

Nothing in what has been said so far points to interactions between firms within and between industries. Let us start by considering a simple economic system as depicted in figure 8.1. The model system consists of four industries, a 'manufacturing' and a 'service' industry producing goods for final consumer markets and two similar industries that deliver intermediate goods for the two final industries.

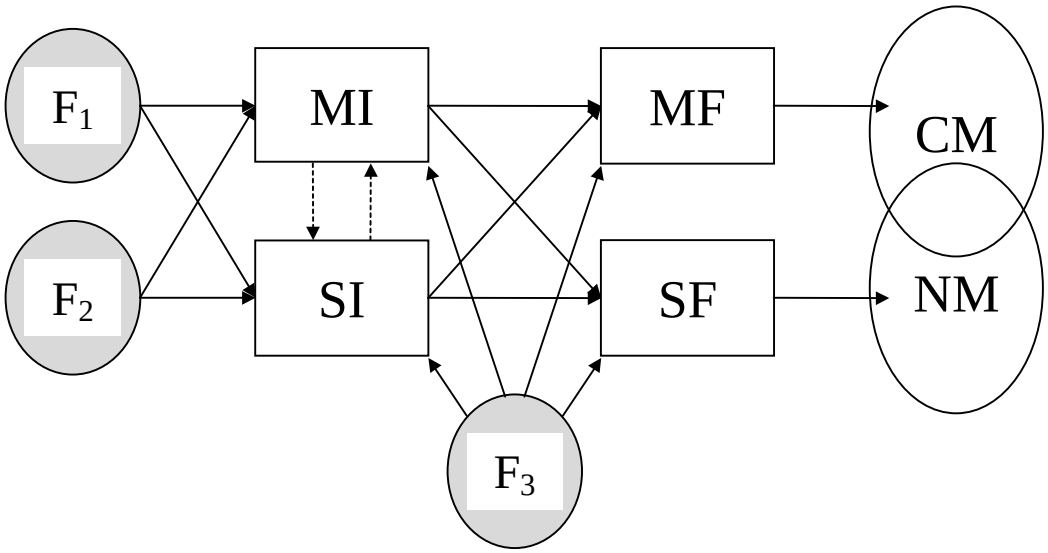

Figure 8.1 A simple production system

The 'intermediate' industries MI and SI use three sets of input factors F_1, F_2 and F_3, in addition to the input factor labour which is not shown in the figure. The 'final' industries MF and SF make use of F_1 and F_2 only indirectly through the intermediate inputs being produced by the 'intermediate' industries. In addition all four industries share the factors F_3 and labour. The production of the 'final' industries is traded in a commodity and a service, or non-commodity, market. The linkages between the participating industries, production factors and final markets describe the flows of goods and services in the system. The parameters that now describe the behaviour of this simple system are factor prices of F_1, F_2 and F_3, the wage rates, technological coefficients for the four industries, describing their production structure in terms of input requirements per unit output, and parameters describing the preferences of consumers.

We will make two further assumptions about the behaviour of this system. First we make the natural assumption that the consumers supply the labour force; the income that generates demand in final markets is earned as wages in the four industries. Secondly, we will mostly assume that supply of any particular good or service is fully elastic, or flexible towards changes in demand for the good or service. That is, any changes or potential imbalances in the relation between supply and demand at any particular location in the system is instantaneously regulated away. With this assumption we are focussing on the long run behaviour of the system, neglecting relatively short term transitional dynamics.

9 On services and manufacturing

9.1 Services and manufacturing - a grand convergence?

Even though there still are variances and differences, we have now come a long way since the first chapters. What we have outlined is proofs and indications of dynamic change processes and interlocking developments between different economic activities. The complex interrelations and contingencies between different economic sectors is of course not something new, it has been noted and commented upon by analysers and observers of economic development several times over the last 200 years. But there is a greater urgency to the issue today, a symptom that the integration and interdependencies of economic systems has grown, and is still growing, substantially out of the framework that reigned a few decades ago. Management 'slogans' like focussing core competencies and managing change, point to this being a perceived reality in the business world. The growth of professional services, the 'R&D-fication' of development in many industrial areas point to the same. Internationalisation, let alone globalisation, increases competitive pressures, as do 'border-less' information and communication technologies.

Simultaneously these processes also affect service sectors, and the 'grand sectors' affect each other. The process is "driven by the increasing sophistication, internationalization, and complexity of management. Specialized forms of services have proliferated as has the complexity of needs in … established services … More complex products and more sophisticated technologies … require more design, operational and maintenance services. The internationalization of competition is powering the growth of services …. Technological and regulatory changes are opening up entirely new service fields" (Porter 1990).

The evidence points to a process that will leave few parts of the economic complex unaffected. Considering what the 'industrial revolution', that took 100 years to restructure the face of the production activities, did, concepts that allegorically refers to this process should be used with care. But the process promises at least to change the framework of future developments of several activities that we traditionally call services, with elements that resembles the processes that changed customised handicraft production into larger scale industrial activities.

The argument is that in many respects, manufacturing and services differ quantitatively more than qualitatively. Furthermore, the grand sectors overlap - some services, especially new technology-based business services, share many features with the more advanced parts of manufacturing, for example, while some manufacturing industries resemble the stereotype of services. And we argue that the overlap is growing - there is a convergence of sectors, though each still has much internal diversity and it is still possible to speak of characteristic features. We can illustrate our approach diagrammatically as in figure 8.1.

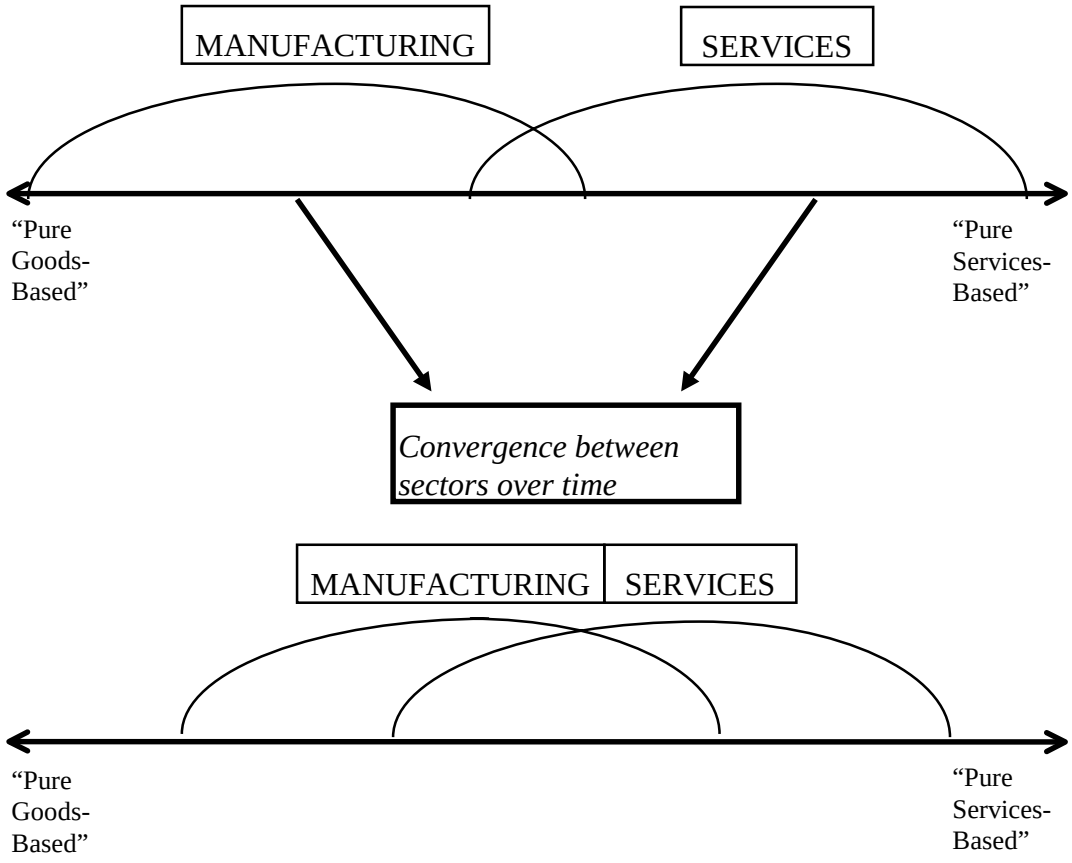

Figure 8.1 The convergence of manufacturing and service sectors. Source: Kastrinos and Miles 1995b. See also Miles 1996

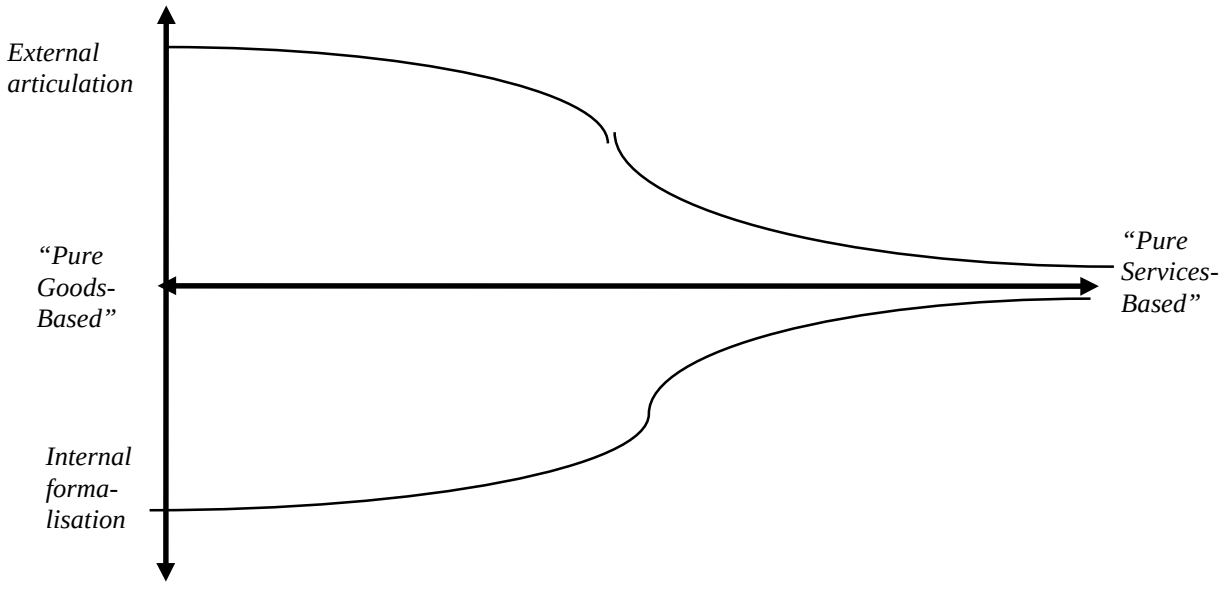

Figure 8.2 The articulation of search activities. Source: Kastrinos and Miles 1995b

Numerous attributes vary along the horizontal dimension. Some of these are characteristics which are used as definitional attributes of services versus goods - intangibility, customer-intensity of production and delivery, level of customisation of the product, and so on. More interestingly, several other features are related to innovation dynamics, as suggested in figure 8.2.

Here the two vertical axes include both factors external to the firm or industry (upper axis) - its articulation into the knowledge infrastructure - and internal features (lower axis) - its degree of extensive organisation and management of the innovation process. It also seems that the level of policy interest and social scientific analysis in different types of economic activity follows a similar sort of curve.

9.2 Knowledge intensity in services

Services as a category of economic activity is essentially a residual, a residual representing typically 2/3 of employment in industrialised countries, and spanning a multitude of activities as diverse as personal and health services, typewriting, hotels and restaurants, ship brokerage and R&D services. Knowledge-intensity, in some sense of the word, evidently plays a role. But knowledge-intensity is hard to define and still harder to measure. As knowledge-intensity reflects the integration with a generic or service specific science and technology base, it can be seen as a combination of knowledge embedded in new equipment, personnel, and R&D intensity. Another way at a microlevel may be to define it in terms of conditions for the transaction between the service provider and the service user or procurer. A simple approach to this would be to try classifying services according to knowledge requirements of service provider and related knowledge requirements of service procurer in a two-dimensional plot. Of course the concept of knowledge in this classification is multifaceted.

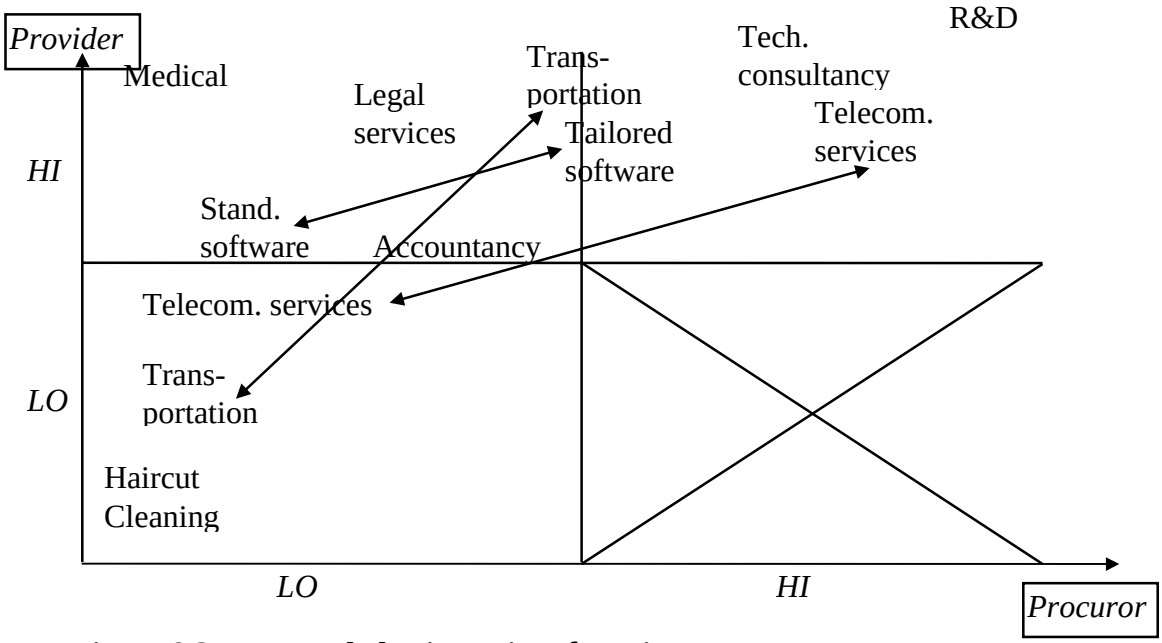

Figure 8.3 Knowledge intensity of services. Source: Hauknes 1994b

Figure 8.3 illustrates what a diagram like this would look like, with some service activities given for illustrative purposes. It is important to note that any service category is not an isolated point, but an extended cloud of points. This is especially so at the aggregated levels given in the figure, where the categories are no longer homogeneous. This is illustrated in the figure by the extensions of transportation, telecom and software services.

Another possible criterion may be classifying services according to the degree of "vertical" or "horizontal" integration, i.e., according to the relative strength of service functions' integration within or between different value-chains or clusters. This classification corresponds broadly speaking to different diffusion patterns. A fourth criterion would be to base the selection on growth potentials, in terms of employment and value creation. These characteristics of knowledge intensity are closely related to market properties.

10 Services and innovation systems

10.1 Services in innovation systems

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

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

First of all services are often treated as consisting of a few, well-defined categories which are homogenous in terms of explanations of the structural changes in these economies. Secondly these services are denied, in some instances by definition, the possibility of any real productivity gains. Accordingly the depicted services may seem to have a simple role in terms of innovation dynamics, primarily as recipients of innovations developed elsewhere. Services are only featured indirectly in most innovation policies - if considered, they are mostly regarded as agents for technical training and support policies towards manufacturing firms or as technology sinks, benefiting from their supplier-dominated character.

This tendency to overlook services appears to be supported by the received wisdom of innovation theory in various ways. But there is a self-confirmatory element in such approaches - by assuming that services' roles are negligible, instruments and approaches have been developed which make it impossible to accurately examine these roles. Suffice it here to point to the manufacturing bias of the present OECD-manuals of the Frascati family, through the R&D, innovation and patent manuals as one reason for this conclusion being a fallacy, almost by construction. On the contrary, service functions play a central role in structural change in the business sector that extends well beyond a management based manufacturing economy, it seems clear that we are only at the beginning of understanding the role of service functions, and service sectors, in innovation systems.

Within the framework of increasing knowledge intensity of our economies and societies, services acquire special importance. To a growing extent - which is poorly recognised by policy analysts - they are critical drivers and carriers of change. The role of services in contemporary systems of innovation is increasingly appreciated, to be sure. But it is poorly researched, and, frankly, not well understood.

There are as we have seen compelling indications of the increasing importance of service sectors in the processes of technology creation which drives value-creation, that is

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

Any understanding of the service sector, and of its role in technology creation and diffusion, must start from a recognition of the complexity of the sector. In statistical classifications, such as ISIC or NACE, the service sector is essentially a residual class: it is composed of activities producing intangible outputs which do not fit into either primary or manufacturing sectors. Of course, the service sector is not one sector at all; it is comprised of extremely heterogeneous activities, which play very diverse roles in overall economic performance. Understanding the service sector is, in large part, a problem of gaining a better conceptual and empirical understanding of this complexity and its implications.

Secondly, it is important to recognise the importance of inter-industry flows between services and manufacturing. Many service sector activities in fact take the form of intermediate inputs, which means that knowledge created in services flows indirectly into the knowledge stocks of user industries; a recent study of embodied inter-industry R&D flows in Norway showed that the largest single R&D-exporting sector was a service industry, namely business services, even without taking into account the lacking coverage of service sectors in public R&D statistics.

Thirdly, what characterises innovations may vary significantly between manufacturing and service activities and in between different service activities. The role of organisational innovations, the blurring of the distinction between product and process innovations, together with the possible need to introduce new categories, point further to the necessity of eliciting the interrelations between economic sectors and activities. In spite of the importance of service activities in innovation processes, it is difficult for service considerations to be integrated in to the concerns driving the design and implementation of technology policies because of the lack of understanding of the underlying dynamics.

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

In the Nordic countries most service sectors have been classified as sheltered industries in national accounts, based on a standard for classification of industries according to competition characteristics. Two recent trends raise the question whether this classification is true. The first trend is the accelerating trend of globalisation of economic and technological activity. For some services previously based on national markets, such as financial services and consultancy, globalisation increasingly means foreign competition on the home market, or the emergence of regional or global markets.

The second trend is related to the fact that several services have been sheltered as a result of institutional, regulatory or corporate governance regimes. The deregulation (or often more aptly, reregulation) policies in several countries, the consequences of the 1987 Unit Act and the effects of the Maastricht Treaty, as well as the Uruguay Round of the GATT, raises competitive pressures on national markets and creates possibilities for genuine transnational markets. This is most clear in telecom services, but these trends may have significant effects also on other service sectors and may prove decisive in terms of the future development of these.

On the basis of the preceding chapters, we may conclude that service sectors are not productivity laggards in the direct sense that economic data purports to tell; but this raises a serious problem for economic policy. As national competitiveness and growth to a large extent is measured in terms of productivity measures, the mismeasurement of service sectors implies a mismeasurement of total productivity change, where the degree of mismeasurement is determined by the industrial structure of the country in question. Thus the quality of international comparisons of competitiveness is seriously affected by the ability to correct for industrial structure.

IV Appendices

Appendix 1: Framework for analysis - the SI4S project

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A1.1 Defining terms

In this section we give a brief description of the main concepts behind the suggested activities. The delineations of the concepts given here describe our initial approaches. The definitions will be developed further in conjunction with the project activities. There are three main concepts that form the foundation of the project,

- the concept of *services*, including the definition of business services,
- the concept of *innovation*, and
- of *knowledge*.

In ordinary usage the term *services* is used as a label encompassing widely differing activities with less in common than many services has in common with manufacturing activities. This reflects the term's negative content, it is defined as a residual of activities. Hence it is no surprise that different commentators give different categorisations of economic activities. This fact alone raises the need for better concepts. We find it helpful to illustrate our approach in terms of the Singelmann categories; of *personal*, *social*, *distributive* and *producer services*, even though a clear cut division of service activities into these categories is impossible. In the preliminary phases we will focus all these service categories, whereas our prime focus in the later phases will be on distributive and producer services.

At the same time there are two factors that point to the need of going beyond this seemingly restricted set of services. There are complementarities between different services across the Singelmann categories and there is a continual development of existing and appearance of new services. The complementary relationships between different services lead us to consider including aspects of educational services, as well as of health and environmental services. Other complementarities imply the need of considering other services, e.g. consumer and public services, as demanding users and their role vis a vis service sector innovation processes.

In the services in innovation part, the concept of business services is given a relational definition, as opposed to a much more restricted definition in terms of statistical categories. Business services are defined as services which (mainly) function as intermediate inputs to other productive sectors, that is, services that have other firms as their main customers. In terms of the Singelmann categories this includes mainly distributive and producer services, but includes as well aspects of social services. In terms of analysis of statistical data, we have to use these definitions in terms of identifying service sectors which predominantly serves other sectors, rather than final consumption.

Innovation is a key concept in the project, but at the same time it is a concept where different research traditions and observers define the concept differently. Service sectors raise fundamental questions to conceptualisations of innovation processes, leading to the need of going beyond the restricted concept of *technological innovations* that is the focus of the 'Oslo Manual' (OECD 1992a). The concept of

innovation is intimately related to organised activities that change characteristics of the market; reflecting the popular definition of innovation as invention plus market introduction. Our concept of innovation starts from this; innovations are *organised activities* by the firm, i.e. deliberate institutional activities, that have the effect of changing some characteristics of the markets on which the firm operates. As opposed to Schumpeter's industry perspective, with his five tier classification of innovations, we will take a firm level perspective. Our main approach will be to focus *deliberate firm level activities*, aimed at generating changes in market characteristics.

As we here do not distinguish between the firm's roles as supplier and customer; this includes innovations referring to both 'upstream' and 'downstream' markets. Secondly a firm level approach make innovation and diffusion complementary, rather than dichotomous, concepts. Thirdly the innovation concept involves the introduction of something new, whether new to the market or new to the firm. That is, the change in market characteristics is related to a change in firm characteristics. This excludes activities like price dumping that may change market features, like price and demand structures, but are unrelated to concomitant changes in organisational features of the firm. We also use this restriction to exclude market strategies like brand naming. The market approach further imply that we exclude, although productive, non-market activities like governmental services. In many instances though such changes will involve technological dimensions or issues. Thus technological innovation may be used as an identificatory device for many innovations.

The significance of *knowledge* is focused by the importance of learning processes to innovation. Similar to the definition of innovation as organised activities, a related concept of knowledge is *organised* knowledge. Organised knowledge requires a process of organisation by the firm, a process pointing to organised knowledge being knowledge with strategic significance for the firm. The concept does not exclude tacit knowledge, on the contrary it is important to include tacit knowledges, expressed in practices, routines and skills; in 'the way we do it here'. This concept is associated with *organisational* or institutional *learning*, and include both formal and informal learning; routine and skill development, learning-by-doing, -using and -interacting, deliberate search activities, hiring of specialised personnel, contracting of R&D institutions, etc. These learning processes are incorporated into the organisation as organised knowledge; as scientific, market related, or managerial knowledge, as routines and skills, and more; knowledge 'bases' that shape innovation ideas and processes.

Learning presupposes knowledge flows, a fact that together with the organised aspects of innovation activities and the associated learning processes, stress the importance of a systemic approach to the issues raised. A central question that links together the different parts of the project and its relevance for the central question of services roles in national innovation systems, is how learning and knowledge flows affect and are affected by services.

A1.2 Data and methodology

As is evident from the description given above of the project content the way of analysing the issues and answering the main questions is through four main approaches,

- analysis of publicly available data sources,
  - macroeconomic data,
  - firm level data,
- two questionnaire surveys, supplemented by case studies, and statistical and qualitative analysis of data generated by these,
- development of concepts and theories,
- assessment of service dimensions in national industrial and innovation policies.

A1.3 Selection criteria

There are three dimensions to selection processes within the project activities,

- selection of service sectors and functions to be focused,
- selection of contact and transfer mechanisms between these services and other sectors of the economy,
- selecting forms of 'learning processes' and knowledge.

The possible selection criteria along each of these dimensions are clearly intertwined. It is evident that we cannot consider every aspect of every service related to these dimensions and the issues we consider in the project; along each of these dimensions we have to consider significant services and mechanisms, where significance is determined on the basis of relevance for services roles towards innovation processes.

As mentioned the first part will consider a wide set of services and their relation to the economy as a whole. One significant aim of this part of the project is to explore questions related to interactions between services and other economic activities. The contact mechanisms that will be considered are economic transactions, R&D collaborations and joint ventures, other collaborations, transnational companies and networks, material investments and personnel mobility.

The further selection will be done using significance criteria that will be discussed in this project. The selection will involve assessing a combination of economic characteristics, as measured f.i. in terms of national accounts, and characteristics of innovation dynamism and integration. Evidently knowledge change and intensity enter the picture, but not on the expense of other criteria; this is not a project of knowledge intensive services alone.

But knowledge intensity is hard to define and still harder to measure. The concept of knowledge we are considering is multifaceted and multivaried. Mapping knowledge structures should of course include the relations of the service function with the science and technology base. Knowledge-intensity measured in terms of a variety of indicators, related to transactional features with suppliers and customers and extensive knowledge generating and transforming processes, should be one

supplementary criterion, as would the linkages of services to national R&D programmes and institutions.

At a less extensive level, knowledge intensity is seen as a combination of knowledge embedded in new equipment, personnel, and networks in which the firm participates. At a microlevel we will try to approach it in terms of conditions for the transaction between the service provider and the service user or procurer. Ultimately we also have to consider the genuine firm specific knowledge that resides in the firm itself *qua* organisation.

We will examine different classification schemes and the way in which service functions cluster in relation to these criteria in different countries. This will give us a basis for geographical mapping of service functions and knowledge infrastructures. This in turn will inform our decision as to what service sectors and functions should be looked at in more detail in subsequent stages of work.

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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.