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Towards a Neo-Schumpeterian Theory of Innovation in Services ?

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Abstract

The economics of services is seeking an appropriate theory of innovation. *A priori*, a neo-Schumpeterian approach does not seem incompatible with the principal traits of the service economy. This article poses the following question. To what extent do neo-Schumpeterian analyses of innovation account for innovation in services? It offers a critical appraisal of attempts to apply these ideas to services, from simple conceptual and methodological transpositions (transposition of analyses of paradigms, technological trajectories and sectoral taxonomies of forms of technical change) to attempts to create more complete theoretical constructs.

Introduction

The economics of services is seeking a theory of innovation appropriate to its specific features. The bulk of the literature on "innovation in services" utilizes "technologicistic" and "industrialistic" concepts and has in practice examined *technological innovations applied to services*.

The most obvious explanation of this bias is the sheer scope of the processes of technology adoption and their impacts on economic variables as significant as productivity, employment, skills, trade, and so on. Indeed which the tertiary was long considered a sector of low capital intensity, services are now the principal users of information technologies across all the developed economies (Kutscher and Mark, 1983; Guile and Quinn, 1988).

Because it contributes to creating a "mechanistic" analysis of production and a restrictive and "technological" vision of innovation that are particularly inappropriate to the fundamental characteristics of the service economy, the implicit or explicit utilization of standard neoclassical theory also plays a role in this "technological" bias. This theory is based upon hypotheses¹ that are incompatible with the characteristics of the service economy. It leads to a focus on process innovations that are incorporated into producer goods, and fails to take into account the tacit and idiosyncratic dimensions of techniques that are particularly significant to service activities.

A number of *ad hoc* empirical analyses have been undertaken in recent years with a view to moving beyond this "technological" approach and take into account the specificities of services innovation. Though by no means an exhaustive list, we can cite examples of integrationist and functional approaches (Belleflamme, Houard, Michaux, Ruysen, 1986; Barcet, Bonamy, Mayère, 1987), managerial approaches (Norman, 1984; Eiglier and Langeard, 1987; Lovelock, 1992) and service-based or service trajectory approaches (Gallouj, 1991; Gadrey et al., 1993; Sundbo, 1993, 1994). These different studies share the objective of proposing a typology of services innovation that attempts to circumvent the problem of the traditional distinction between product and process innovation².

This article does not review these analyses³ but examines services from the perspective of neo-Schumpeterian theories of innovation. The goal is to reflect upon the following question. To what extent do neo-Schumpeterian analyses of innovation help take into account services innovation? Faithful to the Schumpeterian tradition, these theories in practice adopt a broad definition of innovation as a non-maximizing, interactive, cumulative, specific and institutionalized process (Amendola and Gaffard, 1988). In contrast to the hypotheses of standard neoclassical theory, their hypotheses do not, *a priori*, seem incompatible with the principal traits of the service economy. The article examines the transposition, into the services sphere of the concepts of the technological and technoeconomic paradigms (Part 1), and the technological trajectory and attempts to construct sector-based taxonomies of the forms of technological change (Part 2). The "*reverse cycle*" model of Barras goes beyond these conceptual transpositions since it proposes a theory of services innovation along Schumpeterian lines; a detailed critical analysis is presented (Part 3).

1. Technological and technoeconomic paradigms and services

Dosi (1982:152) defines the technological paradigm as "a 'model' and a 'pattern' of solutions of *selected* technological problems, based on *selected* principles derived from natural sciences and on *selected* material technologies". Perez (1983, 1985) enriched this concept by

adding a more economic content (by taking greater account of the consequences of changes on the structure of costs of entry and on conditions of production and distribution) and proposed to call this a "techno-economic paradigm". The techno-economic paradigm is related to the Schumpeterian idea of "creative destructive force" and is characterized by its pervasive impacts on the whole economy.

In this part of the article the modalities (and difficulties) of transposing the concept of the technological paradigm and the enriched concept of techno-economic paradigm to service activities are examined. The link between services and the technological (or techno-economic) paradigm can be conceptualized on two levels: that of the impact of the new paradigm (based on information and telecommunications technologies) on services and that of the role of services in this new paradigm. In practice this notion of a reciprocal effect is much more complex. For example, problems specific to services (at the micro-economic level) have impacts on the form of technological change.

1.1 The impact of the new (information) paradigm on services

The main body of the literature implicitly or explicitly related to services innovation focuses on this generic theme. It is not necessary to present an exhaustive analysis of this theme, since the aim is to identify a number of questions the significance of which helps explain why there is less interest in services innovation in its own right.

Very schematically and *ceteris paribus*, it is possible to identify two models of successive technological innovations - the first corresponding to the introduction of heavy computerization, the second to the introduction of decentralized computerization - and to examine the impact of each on employment, skills, the organization of tasks, productivity, trade, and the quality of the "service-product" (quality). The matrix representing the two models on one axis and these principal analytical concerns on the other axis encapsulates a large part of the economic debate related to "innovation in services". An approach such as this is certainly reductionist : other factors (eg competition) affect the various elements which are not analyzed in this paper; one model follows the other yet they are not necessarily substitutes. However, the procedures adopted in many studies are wholly or partially contained within this 'matrix'. Examples are the studies by Petit (1988, 1990), Bertrand and Noyelle (1985, 1987a, 1987b), Cossalter and Hézard (1983), Adler (1981), Rajan (1985, 1987) and Tremblay (1989), which cover most of the matrix, although some of them miss out trade. In fact this last issue has arisen the most recently. In its "international exchange" dimension it includes many studies conducted at various levels but particularly in the context of GATT. In this connection studies such as those by Soete (1987), Noyelle (1989), Howells

and Green (1988), Daniels (1982), Rada (1987) and Miles and Wyatt (1991) can be cited. A review of the significant body of literature that corresponds to this matrix would not be particularly useful here. Instead, the following “ stylized facts ” can be outlined.

As far as the first model is concerned (introduction of heavy computerization), it is generally accepted that the impacts theoretically expected include: increased productivity, reduced employment and deskilling of the workforce. This first model corresponds to the computerization of *back-office* tasks. It is based upon the standardization and Taylorization of tasks (data retrieval) and the exploitation of economies of scale.

In the second model (the introduction of decentralized computerization), by contrast, the principal hypotheses theoretically tested can be summarized in the following question: does the introduction of decentralized computerization not entail higher employment, a reskilling of the workforce and increased productivity? In practice, decentralized computerization is related to diverse tasks and not solely the back office. Moreover, it tends to bring about economies of variety and to reduce routine tasks in favour of more reputation-enhancing tasks such as consulting and commercial activities.

In both cases, a significant portion of the literature consists of presenting these theoretical hypotheses and their mechanisms, confronting them with reality and attempting to interpret the discrepancies. A question of major theoretical importance which runs across both models and several studies is what is known as the "Solow paradox". This is the observation of a simultaneous decline in productivity and acceleration of technical change in most of the developed economies since the early 1970s.

The analysis of the impact of technology investments on the nature of the "service-product" should bring us nearer to the problem of service innovation itself. Yet this issue most often remains secondary in relation to other analytical priorities. It is true that in the first model, the technological innovation adopted generally entails little change in the "service-product". But while in the second model there are possible impacts in terms of "product" and "service" innovations, they are rarely examined in any depth.

The main lesson to be drawn from the preceding remarks is the following: the adoption of technical innovations in services has significant economic and theoretical consequences, the analysis of which has mobilised a large number of researchers. This justifiable focus of economic research has contributed to a neutralization of attention paid to innovation "internal"⁴ to services.

1.2 The place of services in the new paradigm

The second aspect of the question consists of viewing services (or some of them) as constitutive elements of the new techno-economic paradigm in the sense that they create the material or non-material technologies that are part of the basis of this paradigm. The question then becomes whether they participate actively and significantly in this paradigm or whether they are merely a secondary and subordinate part of it.

To the extent that the technological trajectory represents the gradual exploitation of a "technological potential" under the various forms that neo-Schumpeterian economics gives it (paradigm, "guide post", new technological system, etc.) service innovation in the strict sense can be considered to be the ultimate (optimal) exploitation of a given potential. It is in this sense that one must interpret the following declaration by C. Freeman (1982, p.5):

"This is not to underestimate the importance of dissemination of knowledge through the education system, industrial training, the mass media, information services and other means. (...). It is only to assert the fundamental point that for any given technique of production, transport or distribution, there are long-run limitations on the growth of productivity, which are technologically determined. (...). Education and training of the labour force, efficient communications, additional capital investment, economies of scale, structural changes, plant reorganization, and the application of management skills may all be regarded as the systematic exploitation and 'follow-through' of scientific discovery and technological innovation."

It appears that, in practice, the introduction of the service dimension into industrial activities - as, for instance, in its day, the establishment by companies of "after sales service" or "consumer services" - can be interpreted as a service innovation that originates in the optimization of an industrial innovation to which it is subordinate. From this perspective, service innovation does not have its own purpose; it only exists to confer the status of innovation on a given good. This notion of the subsumption of the service to the good and the creation of a "good-service" pairing in which the service remains subordinate can also be found in P. Eiglier and E. Langeard (1987).

The idea of a reduced role for service innovation strictly defined, in which it is placed in a subordinate position with respect to a paradigm (here the new technological system) in which the "object" dimension predominates is nevertheless interesting in the sense that it goes much further in its thinking than the theoretical project that is limited to analysing the impact of the new technological system (the new paradigm) on services.

In a more recent article, C. Freeman (1991) is more explicit in his discussion of service innovations. It is true that he only considers them in terms of a purely organisational dimension; his real interest lies in organisational innovations, which he illustrates with examples drawn from service activities. However he breaks with the strictly *subordinate* perspective when he admits that these innovations *may* have few direct links to technical innovations. His examples include supermarkets in the distribution sector, containerization in the transport sector and package holidays in the tourism sector. The roles played by changes in physical equipment (technical innovations in refrigeration, vehicles and communications) in these service innovations is far from negligible, yet these links are not determinant and the service innovations have their own autonomous trajectories.

While these organisational and service innovations are not directly linked to any particular technical innovation they are nevertheless intimately linked to the techno-economic paradigm of which they form a part. The emergence of the service innovations cited above was linked to :

"social and technological trends of mass production, standardization of consumer products, mass markets, car ownership and cheap energy. Thus they were far more influenced by the dominant contextual web of technical and economic development and the dominant style of management (the 'techno-economic paradigm') than by specific technical innovations in each particular sector" (Freeman, 1991, p.221).

According to C. Freeman (1991, p.221) these innovations have to be treated in a way already recommended by Schumpeter, in other words in the same way as all technical innovations that are "part of the general profit-driven dynamic of capitalism".

The existence of service innovations or innovations which affect service functions (organisational innovations) that are directly induced by technical innovations does not escape C. Freeman's notice (p.221): "almost any major process or product innovation will lead to some corresponding organisational change in the company, for example changes in training systems, in maintenance procedures, in technical services and so forth". They may also lead to organisational changes (service innovations) beyond the innovating companies and thus cause the emergence of new service activities, such as the opening of garages to maintain and repair vehicles, or information consultancy.

Moulaert et al. (1991) move even further away from the subordinate interpretation of the role of services in the technological paradigm. Their interest lies in high technology services and they defend the thesis that "the recent revolution is as much a revolution in professional services and more precisely in high technology consultancy as a hardware revolution". Their

principal reasons are as follows: the central role played by high technology consultancy in the development of the new technological paradigm; the strong growth in this kind of activity over a number of years; and the tendency towards a certain autonomy in the location strategies of high technology consultancy activities with respect to the locations of equipment producers.

In a recent study, F. Djellal (1995) develops this idea at length. She proposes substituting the concepts of the paradigm and the technological or techno-economic trajectory (still dominated by a technologicistic and economistic logic) with a socio-technical paradigm and trajectory. Backed up by concepts of regulation theory and institutional theories she takes into account organisational, institutional and social dimensions of innovation. As with the "science based firms" in Pavitt's taxonomy (see below) information technology consultancy firms, which articulate knowledge of hardware, software and orgware, are active agents in a socio-technical paradigm. If we accept the definition of innovation as *problem solving activity* (Dosi, 1982) it would appear to be possible to extend this thesis to all consulting activities. Given that in practice these activities are generally themselves defined as legal, economic, technological and social *problem solving activities*, it can be said that they actively participate in the new socio-techno-economic paradigm.

1.3. More complex reciprocal relations

There are a range of links between technological innovations and service innovations. The links between a Boeing 747 and air transport or the French TGV and rail transport are of a different nature from the links between a consultancy service and a computer, or a bank and its automatic teller machine, or McDonald's and its cooking apparatus. For a proper understanding of the mechanisms of innovation in services it is necessary to understand the nature and multiplicity of these links. Thus the following range of situations, which are neither exhaustive or exclusive, can be identified.

1) *The innovative technical tool as a 'supplier' of the existing service.* In this case the linkage is one of substituting technical capital for human capital. This substitution may take place in the back office (and not concern the client directly) or at the interface. In the latter case it may be total (complete self-service) or partial with the provider supplying the existing service (for instance, a reservation, a banking transaction) with the *aid* of a innovative technical tool. A "man-machine" relationship is substituted for the traditional "man-man" service relationship, internal or external⁵. The innovation is basically to be found on the side of the machine, even though in this case what is called the "existing" service also tends to be transformed incrementally (response lead times, availability, a broadening or sometimes

reduction of possible responses). Examples include automatic teller machines, "information and advice displays" in some banks, "advice and promotion displays" in some shopping centres, transport timetable services and reservation systems. It is here that we come across the theory of self-service (Gershuny, 1978, 1983; Gershuny and Miles, 1983).

2) *The innovative technical tool as supplier of innovative services.* In this case there is innovation in both the technical tool and the service provided. The nature of the service provided determines the use value of the technology. There is a *relationship of identity, of consubstantiality*, between the tool and the service. There is a long list of such innovations in telecommunication services (improved telephone systems, electronic mailing, high definition videotex, fax). This relationship of consubstantiality between the technology and the service is not very different from the situation in which material goods are defined in terms of the *service they provide*. Saviotti and Metcalfe (1984) base their attempt to measure technological change on this interpretation and on certain hypotheses drawn from the new consumer theory. They hypothesise that a product can be represented by two sets of variables that can be associated respectively with "means" and "outcomes": its technical characteristics (X_i) and its service characteristics (Y_j). Their analysis forms part of the development of an evolutionary theory of technical change. The technological trajectory is seen as "the pattern of improvement of the various X_i , over time"; the technological regime or basic design consists of "a given list of technological characteristics X_i ".

3) *The technical tool as a 'determinant' of the service innovation (in the sense of the emergence of new functions).* This was the way the emergence of information technologies brought about the emergence of new professions and services, not the least of which are the various types of information technology consultancy. Similarly, numerous other producer goods have brought about the emergence of new financial, insurance, consultancy, cleaning, maintenance and location services. Contrary to the traditional model of causation (technology push), in this case the service innovation is not brought about directly by the technology itself but by the technological equipment in which it is incorporated.

4) *Services as diffusers of innovative technology.* Certain service activities help to diffuse technological and organisational innovation. This is particularly the case with high technology consultancy activities (Moulaert, Martinelli, and Djellal, 1990 ; Bessant and Rush, 1995). Another example is travel companies, which influence the technological choices of travel agencies. In these cases the diffusion activity cannot be considered as a mere passive transfer process but as a process of truly "reinventing" the innovation. Hence from this perspective not only do certain services participate in industrial innovation, but they also, and above all, contribute to determining the direction of technical change.

5) *Services as determinants of technological innovation*. For some time now, service providers have exerted strong pressure on material producers to persuade them to produce certain types of equipment or software. This "determination" is exerted not only towards suppliers of high technology, but also includes other clients and suppliers. The major retailing firms, for instance, exert strong pressures on the food industry and other production sectors to improve the quality and condition of products, as well as more recently their ecological characteristics (Miles and Wyatt, 1991).

6) *Services as producers of innovative technical tools*. Amongst the various technologic analyses of service innovation this approach is of particular interest because it recognises that services have a role that is not merely passive and related to adoption but on the contrary is very active, similar to that in manufacturing industries. The taxonomy developed by Soete and Miozzo (examined below) recognises this characteristic in certain service firms, particularly in the category "specialized suppliers and science-based firms". Other service sectors that seem, *a priori*, to be more 'traditional', such as cleaning services, display a similar tendency.

2. Services, sectoral taxonomies and technological trajectories

In evolutionary and neo-Schumpeterian theory as in standard neoclassical theory, technological change is considered somewhat exogenous. However, what is given in the former case is no longer a fully formed technology but a "technological potential" (Rosenberg, 1982). The initial technological potential, which possesses an important power of exclusion, develops in a limited number of directions or trajectories that can be retraced *a posteriori* and within precise limits defined by trade-offs between technological and economic factors.

The problem then becomes how to identify these various trajectories theoretically but above all empirically; this is the objective of the taxonomic study produced by K. Pavitt (1984). In a statistical study of 2,000 innovations over the period 1945-1979, Pavitt was able to disaggregate the whole British economy into three categories: supplier dominated, production intensive and science-based. Each of these represents a sectoral model of technical change.

According to Pavitt, most professional, financial and commercial services belong to the supplier-dominated category in this now well-known taxonomy. While in a more recent study Pavitt, Robson and Townsend (1989) separate out an "information-intensive" trajectory within this category, services remain "dominated by suppliers" of technology (of information

technology in this case). Recall the principal traits of supplier-dominated firms. They are generally small. Most of their technology is process technology that comes from equipment and material suppliers external to the particular sector. Generally speaking users are price-sensitive, and the technological trajectory is therefore one of "cost-cutting". The principal modes of appropriating technology are non-technical and include registered trade-marks, marketing and advertising strategies and aesthetic design.

As noted by Dosi and Orsenigo (1988), "in these sectors the innovation process is basically a process of diffusing producer goods known as "best practice capital goods" and innovative intermediary inputs... made by companies external to the sector". To the extent that this is so, it is clear that having adopted an industrialist and technicist definition of innovation and technology Pavitt's taxonomy reproduces the traditional bias.

Yet Pavitt's taxonomy is an overall, macro-economic taxonomy. In order to usefully analyze technological trajectories in services, it is necessary to disaggregate this heterogeneous group; that is, to develop a classification pertinent to the behaviour of its constituent parts with regard to technological change.

This is precisely the project undertaken by T. Lakshmanan (1987), who adapted a typology developed by Peter Mills (1986) and identified the following three principal types of services: "service dispensing activities", "task-interactive services" and "personal interactive services", the principal characteristics of which are reproduced in Table 1. The results he obtained are summarised in the same table. His taxonomy of service activities permits him to identify a different technological trajectory for each type of sector.

Hence, according to Lakshmanan, the "service dispensing activities" appear to follow what R. Nelson and S. Winter (1977) call a "natural, technological trajectory", in other words a process of mechanisation and exploitation of economies of scale. Dominated by a logic of standardisation, this type of service adopts technologies that are similar in certain respects to the technologies used to produce goods. These are machines capable of treating large volumes of information or material. Good examples include check-out tills at supermarkets (which in some ways resemble industrial assembly lines), technologies to handle letters in postal sorting centres, and various aspects of the mechanisation of fast-food (heating and cooling technologies).

The technological trajectory being followed in some services belonging to the "task-interactive" and "personal-interactive" categories is different. The goal here is to reduce communication costs. A significant aspect to this problem is therefore the acquisition and

processing of information. Not surprisingly it is information and telecommunication technologies that are preferred here.

Over and above this simple attempt to test the evolutionary concept and methodologies by means of sectoral taxonomies and technological trajectories, a further interesting aspect of the work of T. Lakshmanan is to draw attention to what he calls institutional innovations and their articulation with technological innovations. Institutional innovations are defined as changes to the rules that govern modes of interaction between individuals in a firm or organisation. Self-service, co-production, "monitoring" and bonding⁶ are examples of this type of innovation.

This analysis reveals that there are links not only between sectors of activity and particular technological trajectories, but also with particular institutional innovations. Indeed there appear to be institutional trajectories. Not only does the introduction of technical change depend upon the nature of the interface between provider and client but it also helps to modify this interface.

While Lakshmanan's work suggests the usefulness of introducing the concept of institutional innovation (or, more simply, organisational innovation), he does not pursue it further. The idea of institutional innovation in the sense accepted by Lakshmanan is but one component of the social innovation defined by Normann (1984, p.84) as 'innovation that creates new types of social behaviour that use social or human energy more efficiently, that link social contexts to each other in new ways'.

Defined thus, social innovation is not limited to the mode of participation or mediation with the client, but also includes social trajectories (institutional or organisational) as follows (Crozier et al., 1982):

- the utilisation of human or technical production capacities which are un-used and only require to be used. Some computer services firms are said to have originated in a desire to utilise the overcapacity of the computer departments of large companies.
- the introduction into an organisation of new functions leading to new roles or sets of roles. The best known example of this type of social innovation is that of the "*gentils organisateurs*" (GO) at Club Méditerranée.
- making contacts between contexts and actors with potentially complementary needs. In France, J.C. Decaux is an example of this type of social innovation⁷.

Insert Table 1

The classification proposed by Lakshmanan is not, however, a taxonomy in the sense used by Pavitt. In practice the different types of (services) are given *a priori* along with the hypothesis that they behave differently in terms of innovations (technological and institutional). Hence the types are not constructed *a posteriori* on the basis of different criteria.

L. Soete and M. Miozzo (1990), by contrast, utilise Pavitt's criteria to propose a taxonomy that is specific to services. They identify three types of firms or sectors: a "supplier-dominated" type (dominated by suppliers of equipment and technical systems); a type that they call "scale intensive physical and information networks" which corresponds to most services dominated by the processing of codified information (banking, insurance) or activity related to goods (trade, transport); and a type that they call "specialised suppliers and science-based firms".

insert Table 2

The category of "services dominated by equipment and technical suppliers" corresponds to the most traditional vision of services. Firms in this category do not participate significantly in the production of the process technologies they utilise. L. Soete and M. Miozzo classify them under two sub-categories: personal services (repair services, cleaning, bars and restaurants, hotels, retailing, laundry, beauty services, etc.) and public and social services (education, health care, public administration).

The two sub-categories are associated with different sizes of firm (generally small in the first case, large in the second), different sensitivities on the part of users (performance in the first case, quality in a wider sense in the second) and different modes of appropriating the innovation (in the first case non-technical means such as professional know-how, aesthetic design, brand name, advertising; in the second case appropriation is not permitted or is public).

Two other types of service firm, "physical and information networks" and "specialised supplier and science based firms", participate to a greater extent in the production of technological innovations. The technological trajectory of network firms is based on cost reduction and a networking strategy. These types of firm are large and their principal modes of appropriating technology are standards and norms. Users are price sensitive. Soete and Miozzo further divide them into two sub-categories: firms associated with physical networks (transport, wholesale distribution) and firms associated with information networks (finance, insurance, communication). They note that just as in industry there emerged departments of

engineering and production techniques responsible for the proper functioning and the improvement of production techniques, so the services are seeing the emergence of departments of network engineering, particularly in firms associated with information networks. Examples include Citicorp, which set up its own automatic tellers (Glaser, 1988) and Federal Express which developed the COSMOS and DADS⁸ systems as well as systems for mass sorting (Nehls, 1988). While manufacturing industry reappears here as a supplier of equipment and technical systems, it is important to recognise a certain reversal of power relationships, as revealed by the frequent intervention of client service firms in the specification of the technical tools. Here it is incorrect to speak of service firms as dominated by technology suppliers; it is more appropriate to talk of "services dependant suppliers", as Soete and Miozzo call them.

The category of specialised suppliers and science based firms is characterised by a significant output of technological innovations mediated by research, development and software activities undertaken by the service firms themselves. This is the case of business services that maintain close relationships with R&D, information technologies and telecommunications. This type of firm is relatively small and the users are more sensitive to the performance of the technologies than to their price. Their characteristic technological trajectory is based on the system design. The principal means of appropriating technology are R&D know-how, copyright and product differentiation.

Three comments can be made about this taxonomy, none of which reduce its interest:

1) It appears to be largely conceptual and deserves wider empirical testing.

2) It is an application of Pavitt's model to the services only. It does shed new light on technological trajectories in services. Moreover, the "targeted" analysis undertaken by the two authors permits us to progress beyond the idea of services as simple adopters of technologies. Indeed some services are themselves producers or co-producers of these technologies. However, only material technologies (incorporated into equipment) are really considered. Nothing is said about non-technological innovations, unlike in Lakshmanan's classification in which institutional innovations are at least suggested. The taxonomy developed by Soete and Miozzo ought perhaps to be broadened in the direction of taking into account aspects and forms of innovation and services that are not strictly technological.

3) The third comment concerns the taxonomies of both Soete and Miozzo and Lakshmanan. Both taxonomies are based on an approach that is both institutional (the firm) and sectoral (a set of firms with the same technological behaviour). This approach appears to have certain

limitations, particularly given the development of networks in many service activities. In other words, the network idea (and the corresponding technological trajectory) should constitute not so much one of the types within the taxonomy and rather a characteristic that is transversal, a trait of several, if not all types. Hence, for example, in the category that Soete and Miozzo call "supplier-dominated" significant networks have developed. Examples include certain hotel and restaurant chains and certain chains of "temp" agencies. Similarly, the category of specialised suppliers and science based firms is characterised by the development of networks. Indeed it is in this category that the major international accounting and consultancy firms (the Big Six) and the largest international computer services and engineering firms are to be found. The recognition of this problem then leads to a reconsideration of the issue of the relative size of firms. In practice, there are also many large firms in the categories of "supplier-dominated services" and "specialised and science based services".

This problem was anticipated by Soete and Miozzo themselves, when they noted that communication services belonged to both the network firms category and the science based firms category. One way to resolve this problem may be through functional decomposition. J. Gadrey's (1992) attempt is of interest here. Gadrey identifies three types of operation in the service process:

- those that consist of processing tangible objects, in others words transforming, moving or maintaining them (material logistics and transformation operations);
- those that consist of "processing" codified information, ie producing, retrieving and circulating it (information logistics operations);
- those that principally involve the client itself and which are made up of a direct service (with contact).

Each tertiary activity combines these three functions in different proportions, and as well as overall or transversal innovations it is possible to envisage innovations within each of the three dimensions. For instance, the following hypotheses might be proposed:

- the part of the service related to information logistics follows a technological trajectory of reducing communication and networking costs;
- the part of the service related to material logistics and transformation follows a natural trajectory that is more traditional, based on mechanisation and the exploitation of economies

of scale;

- it is doubtless in the contact-type service provision that the institutional trajectory in the sense of T. Lakshmanan can be observed.

The tourist business, for instance, links together these various aspects: information logistics (reservation systems), material logistics (transport and accommodation) and contact-type provision. Accordingly, it is likely that different socio-technical trajectories are at work. In insurance companies where the information trajectory dominates, there are other trajectories related to direct service in areas such as assistance in returning home following a holiday accident, prevention, improvement of interfaces (reimbursement deadlines, etc.). These trajectories can be found alongside another trajectory that is linked to material logistics (the organisation of transport systems in cases of assistance in returning home; or, in the case of an accident involving damage insurance, a choice given to the client between monetary compensation and recourse to an agreed provider to repair the damage).

3. A neo-Schumpeterian theory of service innovation: Barras' reverse cycle model reconsidered

Barras' model (1986, 1990) is without a doubt the first explicit attempt to create a theory of innovation in services following the Schumpeterian line. Barras takes an important step forward in our understanding of certain aspects of innovation in services. He develops a coherent theoretical synthesis of most of the debate on the impacts of new technology on services: impacts in terms of productivity, employment, and also in terms of changes to the product (see Part 1 above). Barras also views the debate on service innovations from a dynamic perspective. Contrary to the approaches reviewed above which focus on typologies (see Part 2 above), he does not limit companies to a given technological trajectory. Instead, the nature of the trajectory varies from one phase of his cycle to another. However, his model remains sectorally limited and fundamentally technologicistic (see Parts 3.3 and 3.4 below).

3.1 The model described

In certain services (banking, insurance, accounting, administration), Barras observed a product life cycle that was the reverse of the traditional industrial cycle formalised by Abernathy and Utterbacks (1978). The basic act in this theory is the adoption of a producer good in the form of an information and computing system by a service activity. The three phases of the reverse cycle are as follows.

Phase I: incremental process innovation and improvement of service efficiency

The first stage of the reverse cycle is initiated by the adoption, in a service activity, of a new producer good derived from the industrial sector. This is usually an information or telecommunication technology, and in particular a central computer system. The various forms of learning by doing, using, (and, let us add, consulting) lead to a number of incremental innovations which contribute to increasing the efficiency of the service provided, that is, reducing its costs. The automation of back-offices in banks, insurance, administration and accounting companies is based on this logic. More precise examples are given by the computerization of insurance policy records, local government personnel records and payroll, audit techniques and internal time recording in accountancy firms.

The generally "non-programmed" character of this type of innovation is consistent with the observation that at this stage service firms do not actively engage in research and development. In other words this is a situation in which firms are "technologically dominated by supply", to use Pavitt's taxonomy.

Phase II: Radical process innovation and improvement of service quality

After a certain threshold has been crossed, the knowledge and experience base that has accumulated and the introduction of mini and micro-computers which are used in the front office lead to radical process innovations that contribute more to effectiveness than to efficiency. The goal is now to improve the quality of existing services. Examples include the computerised management of housing waiting lists in local public administration, on-line insurance policy quotations, and computerized book keeping services in accountancy firms. The installation of automated teller machines by banks also fits into this category since they not only reduce costs but also increase service quality by facilitating the withdrawal of money, waiting time, and hours of availability.

Phase III: "Product" innovation

The third phase of the cycle involves the production of new services rather than simply improvements to the efficiency and quality of existing services. It should be noted, however, that the new services are still generated by machines and technical systems, including network technologies.

This third phase has barely started, and if it is to take off it will require the creation of an information infrastructure. Network technologies, for instance, lead to experiments with

interactive and fully automated auditing and accounting processes in accountancy firms, complete on-line services in insurance firms, home banking, etc. The services, created by the integration of banking, transport and insurance services, derive from the same logic. One way to describe these "new services" in an overall sense would be to say that they are characterized by three types of changes, related respectively to the place where the service is provided, the nature of the service and the nature of the client-provider interface. The place where the service is provided is no longer the site of production but the site of consumption (home, company). The service is characterised by a greater flexibility and a requirement for more consumer information. The interface is increasingly mediated by technology.

This phase is accompanied by a radical change in the structure and strategy of the service firm. The goal is now to open new markets, with the competitive effort being focused on "product" differentiation.

The production of technology is no longer dominated by suppliers. The interactive innovation process is accentuated, resulting in a situation that may be labelled "user dominated", to parody Pavitt's taxonomy. This new status is of course accompanied by the establishment of an active research and development function, which may take place within specialised departments or through specialist small companies or consultants (Gallouj, 1994 ; Djellal, 1995 ; Bessant and Rush, 1995).

3.2 Product, process and life cycle

Two features that lie at the heart of Barras' model must be discussed. The first is the distinction between product innovation and process innovation, the second is the transposition to the services of the concepts of product life cycle and production process life cycle.

Barras (1990, p.226) is himself aware of the difficulties that arise when trying to interpret service innovation from the standpoint of the traditional product/process dichotomy. He accepts that, because of the specificities of services, the product and its process of delivery are inextricably interlinked. This point does not, however, lead him to reject the dichotomy, which he justifies as follows: " The more radical the service innovation becomes, the more reasonable it is to identify the resultant improvements in service delivery as "new services" ". This is illustrated by the example of services based on interactive networks, such as banking or purchasing from home. Conversely, there are numerous situations in which the process changes (organisation, productivity increases, etc.) with no detectable modifications to the service. This can occur when the conventions which define the service concern not the

process but the later results, as, for example, in the case of restaurant, maintenance, cleaning, security, telecommunication and transport services.

Yet these arguments do not exhaust the debate on the dichotomy product innovation/process innovation in the context of services.

1) In the first place the principal problem with this distinction is that the very concept of "product" becomes problematic in the services. Trying to envisage change or innovation in a problematic concept only amplifies the problem. For Barras, a radical "product" innovation is a new service that is permitted by the technology. Process innovation corresponds to an unchanged service, created in a different way by a technology that permits improved efficiency (incremental process innovation) or a higher quality (radical process innovation). Hence the difference between product innovation and process innovation is not related to a distinction between materiality and immateriality but rather to the degree of novelty in the service. This kind of vision introduces an unusual distinction between product innovation and process innovation because it does not take into account, for instance, the creation of a "product" innovation in tandem with a process that is itself innovative in order to deliver the "product" in question. This issue is discussed again below.

2) The position adopted by Barras leads in practice to a very reductionist vision of "new services" (new "products"). This is paradoxical in as much as his principal point of reference is Schumpeter, whose definition of innovation was broad. The examples that he gives in the cases of insurance, accounting, and municipal services (respectively, on-line services, fully automated audit and accounts, automated public information services) provide good illustrations. What Barras calls "new services" appear to belong to a category that has been called elsewhere "innovation by formalisation" (Gallouj, 1991) which seeks, to adopt the evolutionary terminology, a constant or natural trajectory in most services, to give 'material form' to services. This reductionist vision can be justified by arguing, as does Barras, that the third phase of the reverse cycle (which corresponds to the predominance of "product" innovations) has barely started. But this argument does not suffice. An important field of innovation that is difficult to reduce to the product/process categories is neglected by the Barras model. This is the appearance of new functions and services independent of technological change: services developed around new fields of expertise in all types of consultancy, new risks or the social construction of new events to insure.

And so, to what extent can the product life cycle concept be applied to services? This question is obviously linked to the previous one. And yet Barras does not raise it, despite the fact that it is a significant problem which has attracted the attention of a number of authors,

and which is of equal relevance for a number of industrial sectors and particularly high technology industries. In some of these industries (for instance, information technology and telecommunications industries), the tendency for the traditional divide between goods and services to disappear makes it difficult to use such 'product' life cycle models. The best example of this situation is without doubt IBM, which has become one of the world's top providers of computer services.

One aspect of the problem in the service sector is the difficulty of clearly identifying its output, because this is intangible. R. Normann (1984, p.81) doubts the usefulness of the life-cycle notion in services. His first doubt is related to the "brokerage" position occupied by services in economic activity. In practice, their function is often one of making contacts, of mediation, of transfer:

"... mediating flows (perhaps of information, money, know-how or human resources) from one context to another. What happens in these contexts (which may be quite turbulent) is so important to the mediator that the S-shaped curve may have almost no significance at all."

The second doubt concerns to what the cycle refers; is it the product, or is it the process? Normann argues that in the case of goods, analysis of the cycle often refers to the product, whereas in the case of services it is preferable to focus on the "service delivery system".

In response to this problem, management theorists (Langeard and Eiglier, 1990) have attempted to transpose the analysis of the production process life cycle by Hayes and Wheelwright (1979) to services. Hayes and Wheelwright transposed the life cycle notion, previously reserved for the product, to the industrial process. They developed a matrix relating product life cycle to process life cycle and indicated optimal trajectories as a tool for the strategic management of innovation.

3.3 A "sectorally limited" model

Barras' thesis is predicated on the existence of "vanguard sectors" (financial and business services) and 'enabling technologies' (information and telecommunications technologies). Further examination of these two notions leads to the conclusion that the field in which the model is valid may be both narrower and wider than Barras imagines.

a) a narrower field of validity?

In practice, despite his broad hypothesis about "vanguard sectors", Barras draws most of his

empirical material from sectors he himself classifies as "pre-industrial" : banking, insurance, accounting and municipal services. The question is, to what extent can this model be transposed to other "vanguard" service sectors? Perhaps Barras' model is basically applicable to the "vanguard" services that are most sensitive to technological development, and is of limited applicability to most other cases.

Two examples drawn from the consultancy sector are illustrative. Legal consultancy in France (see Gallouj, 1992) would seem to meet the Barras criteria for broadly defined "vanguard" sectors. However, thus far this sector has barely opened up to enabling technologies (computer and telecommunications). Yet this has not prevented it from developing other forms of innovation: ad hoc innovations through original solutions (some components of which can nevertheless be reproduced) to a client's problem; opening up of new fields of law through an accumulation of knowledge and expertise; innovation by formalization through the introduction of new methods and association-dissociation procedures (in the sense of Bressand and Nicolaïdis, 1988; see also Foray, 1993; Henderson and Clark, 1990). Conversely, another legal profession, the notary profession, has been relatively quick (compared to other forms of consultancy) to computerize its offices. Yet this does not seem to have led to major innovations along the lines of the Barras cycle. Doubtless in these two cases account has to be taken of institutional rigidities and the degree of complexity and instability in the environment and in the problems to be resolved. Another explanation may be derived from the idea, formulated by F. Bar, M. Borrus and B. Coriat (1989) for the case of telecommunications networks, that there is a two-phase learning cycle: a phase of simple substitution of the new technology for the existing procedures⁹, and a phase of organizational change and innovation. This would imply that, in these legal sectors, Barras' cycle is still in its first phase, that of incremental process innovation.

In an article on the "Solow paradox", P. Petit (1990) argues that Barras' analysis applies best to "the development of all the self-service activities, and thus mostly to consumer services". Self-service is actually a way to use the consumer's own labour as an input, as a means to reduce the labour costs of the service. In some cases it includes the intensive use of "enabling technologies" such as those associated with the development of automatic teller machines at banks.

E. Langeard and P. Eiglier (1990) distinguish between two categories of equipment: 'downstream equipment that participates directly in the realization of the service, and upstream equipment that is disconnected from it'. They argue that the Barras model only applies to upstream equipment brought in from outside and is not valid for downstream equipment.

In other words, the Barras model applies best in the case of activities where there is a significant back office (banks, insurance). It applies less well to consultancy activities, for instance, where the back office is much less significant than the front office (or place of *servuction*).

Hence Langeard and Eiglier on the one hand, and Petit on the other hand, appear to arrive at different and contradictory results as far as the field of validity of the Barras model is concerned. Yet the two divergent interpretations can be reconciled. Thus the first phase of the Barras cycle (incremental process innovation) may apply mostly to activity upstream of service delivery, with the second phase (radical process innovation) applying more to downstream activities (for example, the automatic teller machines at banks). The third phase would therefore concern both upstream and downstream.

These divergent interpretations may in part be due to two significant ambiguities that characterize this model. The first is the problematic transposition of the concept of "product" to services. The second is a possible confusion between two different levels of technology (incorporated into equipment): "enabling" technologies on the one hand¹⁰, and innovations permitted by these enabling technologies on the other hand, which may themselves be incorporated into technical equipment and systems. Hence, for instance, in the spirit of Barras, automatic teller machines are not enabling technologies but radical process innovations, the enabling technologies of which are networks with "dumb" terminals.

b) A broader field of validity?

While it is necessary to reduce or specify the field in which the model is valid and to attempt empirical tests, it also seems possible to consider extending it. The Barras model is exclusively based on the adoption of information and telecommunications technologies by firms in the service sector. This suggests an examination of whether it can be extended in at least two directions: (a) beyond only information and communications technologies (is the Barras model relevant to the adoption of non-information technologies?); (b) beyond only the service sector (is the Barras model valid in the case of the adoption of information technologies by service functions within industrial firms?). We do not try to answer this second question here.

The Barras model does not take account of technologies adopted by services that are not related to the storage, processing and circulation of information but to material logistics (storage, processing and circulation of material), such as technologies for transport,

refrigeration, cooking, cleaning, etc. It also fails to take account of new technologies like medical instruments¹¹, genetics and biotechnologies, etc. Accordingly, the question to which it is necessary to reply is the following: to what extent does the adoption of these technologies by services entail first process innovations and then 'quasi-product' innovations? This question of the broadening of the model's technological base to tertiary activities that are not typically information-based requires specific empirical investigations to be undertaken. In the absence of such studies, the following points can be made:

1) There appear to be good examples of new "service-products", new "formulas" or "concepts" in activities that utilize material transformation and logistics technologies, in distribution, for instance, or in restaurant chains (Pizza Hut, the french "Courte-Paille" or Spizza 30'...). The automation of petrol pumps in service stations, for instance, may be considered a radical process innovation similar to automatic teller machines. Moreover, the opening of sales points in these service stations, using all the techniques of the supermarket and open permanently, is related to 'product' innovation in the sense used by Barras.

2) Moreover, situations can be envisaged in which the Barras cycle is based on a combinatorial adoption of information technologies and material transformation and logistics technologies. This is the case with firms like Federal Express, Chronopost and mail order companies. An example is containerized transport. While this technology is relatively old (Ernst, 1985), it has been a source of process innovations in Barras' sense; in the first place it improved the efficiency of transport without changing the nature of the service itself. The later standardization of container sizes and development of technologies involving the unloading cranes and their standardization have been factors in improving service quality in terms of a greater availability and so on (radical process innovation). With the introduction in recent years of information and telecommunications technologies into maritime container transport, the quality of the service has been improved so much that it is possible to speak of a "new service" in Barras's sense¹². Another example is fast food in the United States. In certain fast food restaurants, cooking and refrigeration technologies are permitting incremental process innovations (affecting the "back-office": the central kitchen). On the other hand, computerized menu ordering systems can be seen as radical process innovations (by analogy with the automatic teller machines of banks, which are considered so by R. Barras).

c) A technologically determined model

In Barras' model every innovation is necessarily based on technological systems. Even the 'product' innovations that appear in the third phase of the reverse cycle are necessarily

supported by technical equipment.

In other words, in the Barras approach, economic and institutional determinants are only evoked as factors that facilitate or block innovation, that is the implementation of technological possibilities, and never as active determinants of innovation. And yet technology (incorporated into equipment) is neither necessary nor sufficient for the process of service innovation. Other factors may in fact play a role, such as deregulation, evolving client and market behaviours, and the characteristics of human resources.

D. Tremblay (1989) confirms one aspect of the Barras thesis, that in the banks innovation has shifted from process to product. However, she differs on two other points. First, product innovation is already the dominant form, as shown by the observable tendency for banks to be organized on product lines. Second, technology is only one factor in a multidimensional causal model which includes the various other factors mentioned above.

Studies in the consultancy and insurance sectors (Gallouj, 1994, 1995 ; Gadrey et al., 1993) confirm that the Barras approach is fundamentally technologicistic, and that a far broader 'causal' model is required. From this perspective, the Barras model is flawed on a number of grounds, which can best be explained by reviewing the cycle phase by phase.

The first phase of the cycle is not in fact specific to services. The learning process, notably learning by doing, is involved in all equipment acquisition in any manufacturing or service sector. The reverse cycle is about the adoption by services of technologies created in other sectors (manufacturing sectors) in rather neoclassical terms during the first phase of the cycle (process innovation and cost reduction) and in neo-Schumpeterian terms during the second phase of the cycle (the idea of a technological trajectory initiated by the first phase). Moreover, there is no place in this approach for the "positional services" (Hirsch, 1976; Scitovsky, 1987) such as the "Euro-class" offered by the airline SAS, design labels, and so on; in other words services that focus not on innovation but on uniqueness and in which the combination of quality and high price is obtained by niche market strategies (Lakshmanan, 1987).

The concept of service quality, which is the focus of the second phase of the reverse cycle, is used in a restricted sense, that of "access time". This is the purpose of the automatic teller machines. If, however, one accepts that the role of technology is to create closer links between the bank and the client, and that perceived quality is a function of the 'distance' between the service provider and the client, it can be concluded (as Barras does) that during the second phase of the cycle technology ought to improve quality. Yet the technologies used

by the banks during the second phase may also have the effect of distancing the provider from the client and therefore lowering a certain type of quality.

When we finally reach the phase that is really specific to services, the phase in which service activities ought to create their own innovations ("new services"), Barras is careful to state that the phase has only just started. Yet if we adopt a non-technological definition of "product" innovation, in the sense commonly used for banking "products" ("formulas" for managing operations, accounts and payments, which can be created without any technological innovation), we arrive at the opposite conclusion, that in banking at least, product innovation is already dominant.

In the adjacent field of insurance, recent studies (Gadrey et al., 1993) reveal the importance of this type of "service-product" innovation which is ignored by the reverse cycle model¹³. It appears that even while in certain situations the introduction of computerization leads to process innovations (in conformity with the Barras model), the design of new 'service-products' in life insurance, damage insurance, or travel assistance often also leads to innovative changes in information systems, a process that is not captured by the Barras model.

In sum, Barras has not in fact succeeded in creating a model of innovation in services. His model is more a model of the diffusion into services of technological innovations from industry.

4. Conclusion

Services and the service relationship appear to have a number of points of convergence with the evolutionary and neo-Schumpeterian framework for analysing economic and technical change.

1) The concepts of technological paradigm and techno-economic paradigm seem sufficiently broad to leave room for services. As already pointed out, if innovation is defined (following G. Dosi, 1982) as a problem-solving activity, it is possible to go so far as to consider nearly all business consultancy activities as innovative and therefore as constituents of the new socio-technical paradigm (Djellal, 1995). It ought to be noted, however, that the intermediate concepts of "guidepost", technological regime, and "basic design" need to be used with care in the services because of their significant material connotation. On the other hand, the intermediate concepts of "technological system" and "bandwagon" are applicable to services.

Examples are the system that is being constituted around the supermarket, insurance, banking and consultancy, and the system that is emerging around various forms of transport, restaurants, hotels, tourism and leisure services. As well as a bandwagon in computers and telecommunications, we can now talk of a bandwagon in goods logistics (retailing) or a bandwagon (not principally related to technology) in business consultancy services.

2) The evolutionary intellectual process, which favours movement and trajectory, does not, *a priori*, seem incompatible with a procedure of defining a service as itself an act, a movement. As the analysis of T. Lakshmanan suggests, it is possible to envisage an 'institutional' trajectory for services, that is, a trajectory not in terms of technological innovations but in terms of institutional (or social) innovations.

3) The behaviour of certain services firms seems to correspond well to the evolutionary hypotheses. In numerous cases, for instance, the development of the service relation itself seems to be more a heuristical type of relationship than an algorithmic relationship of optimization.

Hence the Barras model constitutes a neo-Schumpeterian theoretical synthesis of several studies of "the impacts of information and telecommunications technology on services". It recomposes the various empirical and theoretical ideas and results into a synthetic and dynamic model with an internal coherence. Barras has therefore succeeded in developing what he calls a "theory of innovation". But it is less a theory of innovation in services than a theory of the diffusion to services of technological innovations originating in industry. In other words, the reverse product cycle model remains fundamentally technologicistic: the only innovations in fact envisaged are technological. The emergence of new functions independent of technologies is not recognized.

And so, despite the apparent convergence between evolutionary and neo-Schumpeterian concepts and the service sector, the two fields remain separate from one another in economic theory. As J. de Bandt (1994) has argued with respect to the theory of production as a whole, the two fields will remain separate as long as the analytical objective remains that of using the services to test concepts and methodologies developed in, and for, an industrial context.

Type of service	Key characteristics	Technical innovations	Institutional innovations	Synergistic developments
"Service dispensers" (e.g. retail wholesale, telecommunications, fast food, banks, etc.)	Stable, low uncertainty environments, consumer contact minimal, production technologies known, besoins du client connus, amenable to scale economies, service provider more involved with dispensing services than producing them .	Automation of many processes, ATM, etc. high volume machine technologies	Self-service, standardized service packages.	E.g. Federal express
"Task-interactive services" (e.g. accounting, legal, financial)	Complex environment, moderate to high customer contact, unique customer needs, high information needs, information subject to different interpretations, clients goals known but outcome of solutions uncertain.	Telecommunication for efficiency, quality of service, on-line information systems	Use of consumers for specification of output, forms of coproduction	Information network services, new service products
Personal-interactive services (e.g. health care, welfare agencies)	Dynamic uncertain environments ; client goals imprecise ; cause-effect relationships between solutions and outcome uncertain. Adverse selection, moral hazard	- Machine technology growth rapid (e.g. health) - On-line information systems	- Coproduction - Bonding - Monitoring	Distributed coproduction ; innovation in service output

Table 1: Evolving technologies in the service sector

After Lakshmanan, 1987.

Category of firm	Supplier dominated		Scale intensive physical networks	Information networks	Specialized suppliers/science based	
Typical core sectors	Personal services (repair, cleaning, barber and beauty services, hotels, bars, restaurants, retail trade, etc.)	Public and social services (health, education)	Transport, wholesale	Finance, insurance, communications	Software	Specialized business services
Sources of technology : • manufacturing • services	Manuf.	Manuf. and services	Manuf.	Manuf. and services	Services	
Type of user	Performance sensitive	Quality sensitive	Price sensitive	Price sensitive	Performance sensitive	
Means of appropriation	Non technical	Not allowed, public	Standards, norms	Standards, norms	R-D know-how, copyright, product differentiation	
Technological trajectory	Product design	Improving performance	Cost-cutting and networking	Cost-cutting and networking	system design	
Source of technology	Suppliers	Suppliers	In-house ; suppliers	In-house ; suppliers	In-house ; customers ; suppliers	
Relative size of innovating firms	Small	Grande	Large	Large	Small	

Table 2 : A sectoral technological taxonomy of services : determinants, directions and measured characteristics.
Soete et Miozzo, 1990

References

- Abernathy W., Utterback J. (1978), Patterns of Industrial Innovation, *Technology Review*, 80, June-July.
- Adler P. (1981], Automatisation et travail : le cas des banques, thèse de Doctorat, University of Picardie.
- Amendola M., Gaffard J. (1988), La dynamique économique de l'innovation, *Economica*.
- Bar F., Borrus M., Coriat B. (1989), Information Network and Competitive Advantages : the Issues for Government and Corporate Strategy , OECD, october.
- Barcet A., Bonamy J., Mayère A., (1987), Modernisation et innovation dans les services aux entreprises, Report for Commissariat Général du Plan.
- Barras R.(1986), Towards a Theory of Innovation in Services, *Research Policy*, 15.
- Barras R. (1990)), Interactive Innovation in Financial and Business Services : The Vanguard of the Service Revolution, *Research Policy*, 19.
- Belleflamme C., Houard J., Michaux B., Ruysen O., (1986), Innovation and Research and Development Process Analysis in Service Activities, Report FAST-EEC.
- Bertrand O. Noyelle T. (1985), L'évolution des emplois tertiaires, informatisation, restructuration, formation, Paris, OECD-CEREQ.
- Bertrand O. Noyelle T. (1987a), L'emploi dans les banques et assurances : comparaisons internationales et perspectives d'évolution, *Economie et Humanisme*, may-june, n°295.
- Bertrand O. Noyelle T. (1987b), L'impact des transformations des services financiers sur le travail, les qualifications et la formation, *Formation et Emploi*, n°17, january-march.
- Bessant J, Rush H. (1995), Building bridges for innovation : the role of consultants in technology transfer, *Research Policy*, 24.
- Bressand A., Nicolaïdis K. (1988), Les services au coeur de l'économie relationnelle, *Revue d'Economie Industrielle*, 43.
- Cossalter C. Hézard L. (1983), Nouvelles perspectives de l'informatisation dans les banques et les assurances, CEREQ, collection études.
- Daniels P. (1982), *Service Industries : Growth and Location*, Cambridge University Press.
- De Bandt J. (1994), De l'économie des biens à l'économie des services : la production de richesses dans et par les services, in De Bandt J. Gadrey J. (eds), (1994), *Relations de service, marchés des services*, CNRS Editions.
- Djellal F., (1995), *Changement technique et conseil en ttechnologie de l'information*, Editions L'harmattan.
- Dosi G. (1982), Technological Paradigms and Technological Trajectories : A Suggested Interpretation of the Determinants and Directions of Technical Change, *Research Policy*, 11.
- Dosi G., Orsenigo L. (1988), Structure industrielle et évolution technologique, in Heertje A.

(Ed.)

- Eiglier P. Langeard E. (1987), *Servuction : le marketing des services*, Mc Graw-Hill.
- Ernst M.L. (1985), *Electronics in Commerce*, in Forester T. (Ed.).
- Forester T. (Ed.) (1985), *The Information Technology Revolution*, MIT Press.
- Foray D., (1993), *Modernisation des entreprises, coopération industrielle inter et intra-firmes et ressources humaines*, report for the Ministry of Research and Technology, June.
- Freeman (1982), *The economics of industrial innovation*, Frances Pinter.
- Freeman C. (1988), *Diffusion : la propagation des nouvelles technologies dans les entreprises, les différents secteurs et Etats*, in Heertje A. (Ed).
- Freeman C. (1991), *Innovation, Change of Techno-Economic Paradigm and Biological Analogies in Economics*, *Revue Economique*, n°2, mars.
- Gadrey J. (1992), *L'économie des services*, La Découverte.
- Gadrey J., Gallouj C, Gallouj F., Martinelli F., Moulart F., Tordoir P. (1992), *Manager le Conseil*, Edisciences International.
- Gadrey J., Gallouj F., Lhuillery S., Ribault T., Weinstein O., (1993), *La recherche-développement et l'innovation dans les activités de service : le cas du conseil, de l'assurance et des services d'information électronique*, report for the research Ministry, december.
- Gallouj C., Gallouj F. (1996), *L'innovation dans les services*, Editions Economica.
- Gallouj F. (1991), *Les formes de l'innovation dans les services de conseil*, *Revue d'Economie Industrielle*, n°57.
- Gallouj F. (1994), *Economie de l'innovation dans les services*, Editions L'Harmattan.
- Gallouj F. (1994), *Cycles économiques et innovations de service : quelques interrogations à la lumière de la pensée schumpeterienne*, *Revue française d'économie*, volume IX, 4, Autumn, pp. 169-213.
- Gallouj F. (1992), *Le conseil juridique français : d'une logique professionnelle à une logique d'entreprise*, in Gadrey J. et al.
- Gershuny J. (1978), *After Industrial Society ? The Emerging Self-Service Economy*, London, Mac Millan.
- Gershuny J. (1983), *Social Innovation and the Division of Labour*, Oxford University Press.
- Gershuny J., Miles I. (1983), *The New Service Economy : the Transformation of Employment in Industrial Societies*, London : Frances Pinter.
- Glaser P. (1988), *Using Technology for Competitive Advantage*, in Guile B. et Quinn J.(Eds).
- Guile B. Quinn J. (1988), *Managing Innovation : Cases from the Services Industries*, National Academy Press, Washington.
- Hayes R. Wheelwright S. (1979), *Le cycle de vie du processus de production*, *Harvard-L'Expansion*, Summer.
- Heertje A. (Ed), (1988), *Innovation, technologie et finance*, Basil Blackwell, Oxford.

- Henderson R. M., Clark K. B., (1990), Architectural Innovation : The Reconfiguration of Existing Product Technologies and the Failure of Established Firms, *Administrative Science Quarterly*, Vol. 35, n°1, March.
- Hirsch F. (1976), *Social Limits to Growth*, Cambridge Mass., Harvard University Press.
- Howells J., Green A. (1988), Technological Innovation, Structural Change and Location in UK Services, FAST, AVEBURY
- Kutscher R., Mark J. (1983), The Service-Producing Sector : Some Common Perceptions Reviewed, *Monthly Labor Review*, April.
- Lakshmanan T. (1987), Technological and Institutional Innovation in the Service Sector, Seminar "Research and Development, industrial change and economic policy", University of Karlstad, Sweden, June.
- Langeard E. Eiglier P. (1990), L'innovation de service, document de travail pour les rencontres chercheurs-professionnels des services, Paris, march.
- Lovelock C. (1992), A Basic Toolkit for Service Managers, in C. Lovelock (ed), *Managing Services : Marketing, Operations, and Human resources*, Prentice-Hall International Editions.
- Miles I., Kastrinos N., Flanagan K., Bilderbeek R., Den Hertog P., Huntik W., Bouman M. (1995), Knowledge-Intensive Business Services : Users, Carriers and Sources of Innovation, Rapport pour DG13 SPRINT-EIMS, March.
- Miles I. Wyatt S. (1991), L'évolution technique des services et leur compétitivité dans le commerce international, UNCTAD.
- Mills P.(1986), *Managing Service Industries : Organizational Practices in a Post Industrial Economy*, Cambridge Mass. Ballinger.
- Moulaert F., Chikhaoui Y., Djellal F. (1991), Locational behavior of french high-tech consultancy firms, *International Journal of Regional Research*, vol. 15, n°1.
- Moulaert F., Martinelli F., Djellal F. (1990), The Role of Information technology Consultancy in the Transfer of Information Technology to Production and Service Organizations, Nederlandse Organisatie voor Technologisch Aspectenonderzoek.
- Nehls C. (1988), Custodial Package Tracking at Federal Express, in Guile J. et Quinn B. (Eds).
- Nelson R. Winter S., (1977), In Search of Useful Theory of Innovation, *Research Policy*, vol. 6.
- Normann R. (1984), *Service Management : Strategy and leadership in Service Business*, John Wiley and Sons
- Noyelle T. (1989), Professional Business Services and the Uruguay Round Negotiations on Trade in Services, Report for UNCTAD.
- Pavitt K. (1984), Sectoral Patterns of Technical Change : Towards a Taxonomy and a Theory, *Research Policy*, 13.

- Pavitt K., Robson M., Townsend J. (1989) Accumulation, diversification and organisation of technology activities in UK companies, 1945-83 in Dodgson M. (ed), *Technology Strategy and the Firm : Management and Public Policy*, Longman Harlow.
- Perez C. (1983), Structural Change and assimilation of New Technologies in the Economic and Social Systems, *Futures*, vol. 15, n°5, october.
- Perez C. (1985), Microelectronics, Long-Waves and World Structural Change New Perspectives of Developing Countries, *World Development*, 17
- Petit P. (1988), La croissance tertiaire, *Economica*.
- Petit P. (1990), Emploi, Productivité et technologies de l'information : le cas des services, IRIS Seminar, University of Paris XI Dauphine "Skills and competitiveness", 5 april.
- Rada J. (1987), Information Technology and Services in Giarini (O.) (Ed.), *The Emerging Service Economy*, Pergamon Press.
- Rajan A. (1985), Employment in Multinational Banking : Recent Trends and Future Prospects, Working Paper n°50, Genève, ILO.
- Rajan A. (1987), *Services : the Second Industrial Revolution*, London, Butterworths.
- Rosenberg N. (1982), *Inside the Black Box : Technology and Economics*, Cambridge University Press.
- Saviotti P., Metcalfe J. (1984), A Theoretical Approach to the Construction of Technological Output Indicators, *Research Policy*, vol. 13, n°3, june.
- Scitovsky T. (1987), Growth in the Affluent Society, *Lloyds Bank Review*, January.
- Soete L. (1987), Innovation in the Service Sector, Colloque "Innovation, Productivity and Growth in the Services Sectors, Erasmus University of Rotterdam, 20 november.
- Soete L., Miozzo M. (1990), Trade and Development in Services : a Technological Perspective, MERIT, The Netherlands.
- Sundbo J. (1993), Innovative Networks, Technological and Public Knowledge Support Systems in Services, Roskilde University, mimeo.
- Sundbo J. (1994), Management of innovation in services, *The Service Industries Journal* (Forthcoming).
- Tremblay D. (1989), La dynamique économique du processus d'innovation : une analyse de l'innovation et du mode de gestion des ressources humaines dans le secteur bancaire canadien, PhD, University of Paris I.

Which does not imply that this theory has to be limited to it.

¹ Very broadly, these are hypotheses of nomenclature, non-interaction and product anonymity. These hypotheses contradict the characteristics generally attributed to services, of immateriality, interaction, and 'non-stockability'.

² Integrated approaches attempt to include innovations in goods and services in the same analyses. Hence Barcet et al (1987) identify functional innovations (new functions), specification innovations (new service-products), and production innovations (new processes). From a related viewpoint, in this case focusing on the 'service relationship', or *servuction*, Belleflamme et al (1986) compare innovations in services, production and *servuction*. Managerial approaches identify innovations related to the core service and innovations related to

peripheral services. Service oriented approaches insist that innovation in services has its own specific characteristics, and draw out the particular modalities of innovation in these activities (a particularly high frequency of ad-hoc innovation and of 'immaterial' or service trajectories as well as traditional technological trajectories).

³ For a survey of these analyses, see F. Gallouj (1994), C. Gallouj and F. Gallouj (1996).

⁴ The concept of internal innovation is related to the production of innovations by service activities themselves, whether in the front office or the back office, and is opposed to the simple adoption of technological innovations.

⁵ That is, at the level of the back office or the front office.

⁶ These are the two principal mechanisms that guarantee service quality, and permit the reduction of negative influences such as adverse selection and moral hazard. Monitoring activities are those by which the client controls the provider. Bonding activities refer to the provider's possession of qualifications which assure the quality of its services and its reputation (eg diplomas).

⁷ The service provided by this firm is based on making contact between four groups of actors: local governments which are provided with free bus shelters and are responsible for maintaining them; advertising agencies which rent out high quality and perfectly maintained sign boards (the bus shelters); bus passengers, and the public in general which benefits from this so-called urban furniture.

⁸ DADS (Digitally Assisted Dispatch System) is a computer-aided delivery system. COSMOS (Customers, Operations, and Services Master On-line System) is a system permitting parcels to be tracked from collection to delivery.

⁹ In the first instance the fax machine simply substituted for the postal system.

¹⁰ As in the case, for instance of the insurance, accounting and municipal services sectors: mainframe computers during the first phase of the reverse cycle, mini and micro-computers during the second phase, and networks during the third.

¹¹ Although, in this case, there is a significant information component.

¹² It is now possible to know at every moment to whom each container belongs, what it contains, where it is located, where it comes from and where it is going, where it should (optimally) go once empty, what kind of container it is, if it needs to be repaired and at what price, etc. (Ernst, 1985).

¹³ In particular, a distinction is made between: a "service-product" innovation in the sense of the creation of a new service, formula, concept or contract; a "tailored service-product" innovation, which is an important form in collective life assurance, the insurance of major industrial risks and travel assistance; architectural innovations in the sense of the association-dissociation of existing 'service-products'; and finally, innovations which involve the modification of a service-product, that is modification of specifications or options (new guarantees) where the basic formula is unchanged.