

## Innovation and Innovation Trajectories in Agricultural Extension Services

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### Abstract

*This paper addresses the question of innovations in agricultural extension services. If lots of researches have proposed qualitative or quantitative models to assess the effectiveness of extension services on innovations at farm level, there are much fewer ones about innovations in services themselves. Nevertheless, there are many changes in the technical organization of extension services: impact of new technologies of information and communication, new models of consultancy, etc. Recent developments in the field of the theory of services economics propose new tools for the description of the dynamics of innovation in agricultural extension. Based on empirical analyses of innovations in different sectors of services, a taxonomy of innovations was produced. They discriminate five kinds of innovations: innovations in the competences of advisers, innovations in the material operations linked to services, informational innovations, innovations in the treatment of knowledge, and relational innovations. The different sectors of services are characterised by different combinations of dominant innovations according to different periods of time (determining some configuration of innovations). The succession of these configurations of innovations describes some technological trajectories of innovations for services. Our aim is to test the potential of such analytical tools for the characterisation of the dynamics of innovation within agricultural extension. In this perspective, we carried an historical analysis of extension services in France, the Netherlands and Germany. The investigations show that some similarities can be found between the technological dynamics of extension services in these three European countries.*

**Key words:** Agricultural extension, services, innovation, technological trajectories.

## Introduction

What do we know about innovations in extension services for farmers? This is the question addressed in this paper. There have been lots of researches aimed at describing the contribution of extension services to innovations within the agricultural sector. But there are much fewer researches that focus on innovation in advisory services themselves. Is that to say that the suppliers of services haven't innovated in the last decades, or that the innovation in extension can be resumed to the introduction in services of some new technologies (Internet, software, etc.) produced by other economic sectors such as the computer or as the software industries?

Conversely, several researches about other sectors of services from different social sciences (economy, sociology, management sciences, etc.) have stressed the fact that there exist some specific innovations to services. These researches – that we will group under the name *theory of service economics* - are based on the idea that services activities are specific, and differ from industrial sectors. Thus, some specific analytic frameworks may be designed in order to describe the organization of the production and the innovations within sectors of services.

Such an idea has hardly been tested and applied in the case of agricultural extension. This is the purpose of our paper: we address the questions of the existence of specific innovations in agricultural extension, and of the dynamics of such innovations. In a first part, the conceptual and theoretical framework of the theory of service economics is presented and adapted to the case of agricultural extension (part b). Then, we apply it to the case of the technological evolution of extension services in three countries: France, the Netherlands, and Germany (part c). The results are discussed in the perspective of the institutional transformation associated to the agricultural sectors of European countries (part d).

## Purpose and Objectives of the Paper

The aim of this paper is theoretical. It proposes to discuss the potential of analytical tools from the *theory of service economics* for the description of innovations and of the dynamics of innovations within agricultural extension. This is a first step toward the necessary characterisation of the technical changes within advisory services for farmers. Indeed, there exist a few works in agricultural economics aimed at comparing the efficacy of different suppliers, or of different national systems of extension services. Nevertheless, these studies do not take into account the innovations, or the organizational parameters at the scale of extension suppliers themselves. These studies only compare the efficacy of different ways of financing agricultural extension (public, private, or public-private financing), in terms of support to the growth of the productivity at the level of farm (Dinar 1996) or at the one of national agricultural sector (Esposito 2000).

In such studies, the technical functioning of extension services suppliers, their organization, their dynamics of innovation remain a “*black box*”. In other sector of production than agricultural extension services, some economic studies and some studies from management sciences have highlighted not only the fact that there exist innovation specific to services, but also that these innovations can generate cumulative effects and design technological trajectories. In this paper, we test whether such trajectories can be identified in the case of advisory services for farmers. In that respect, our objective is to explore the potential of applying some analytical tools of *the theory of service economics*.

### Theoretical Framework

There has recently been a renewal of researches about services. This has led to new conceptions and definitions of services, as well as to new conceptual description of innovations within services. Nevertheless, these developments in the field of service economics have hardly been applied to the case of agricultural extension. In this part, we first describe some of the new concepts of the *theory of service economics*. We then explain how such a theory can contribute to a renewal of the understanding of the innovations and of the technological trajectories within agricultural extension.

#### *A Definition of Agricultural Extension as a Service Activity*

The definition of service activities has been a matter of debate in economic sciences for centuries (Gadrey 2000). For a long time, services have been defined as what they were not. Services were everything but agriculture and industry (Fischer 1935). As a result, services were also for a long time considered as an unproductive sector, or as a sector that does not innovate itself. Innovations in services was considered as a passive process, and resumed to the introduction in service firms of technologies produced by other economic sectors (Pavitt 1984).

Nevertheless, there has been a renewal of researches in social sciences about service activities, as well in sociology (Goffman 1968), in management sciences (Levitt 1972, Chase 1978) or in economics (Hill 1977, Stanback 1979, Delaunay and Gadrey 1987). From these different disciplinary perspectives, some positive definitions of service activities were proposed. Some common points between these definitions are that i) it is considered that services do not lead to the production of a good that can be exchanged independently between the beneficiaries and the suppliers of the services; ii) the relations between suppliers and beneficiaries are at the centre of the service activities. They are not only relations that enable demand and supply to meet and match on a market. They are rather part of the process of production itself. Thus, in his most recent definition of services, Hill (1999) put the relation at the core of the definition of service activities. The historical evolution of the modern definitions of service activities are given in the Appendix 1. These definitions have resulted to the settlement of the concept of service relation.

In the line of such definitions, Gadrey (1994) has formalised and developed a representation of the service relation following the first findings of Goffman (1969). In this scheme, the service relation has four poles (*cf.* figure 1.). In the case of agricultural extension, the four poles are: the beneficiary of the service (the farmer), the supplier (the adviser), the organization that hires the supplier, and the object of the service: the transformation of the practices and of the production systems of the farmers.

Gadrey (1994) distinguishes two kinds of interactions between the supplier and the beneficiary of the service relation. The level of the “*co-production*” regroups the operational interactions on the object of the service relation. In the case of agricultural extension, the co-production embodies the direct interactions between farmers and advisers about farmers’ practices and production systems. The second level is the one of the “*co-piloting*”. It embodies the social relation – contractual or conventional - that rules and controls the operations of co-production.

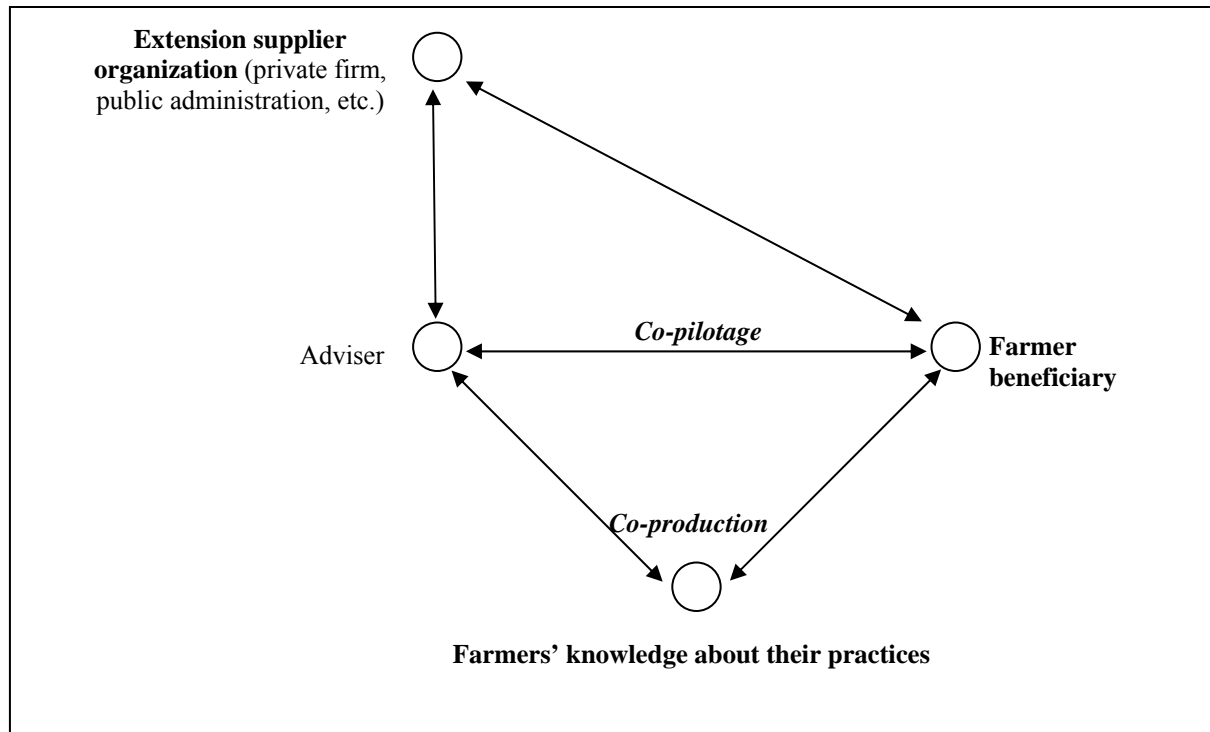


Figure 1. The scheme of the relation of service (from Gadrey 1994) applied to the case of agricultural extension.

Following the economic theory of service, extension can be defined as a service activity. Agricultural extension is aimed at supporting changes in practices at farm level, through the co-production of knowledge thanks to relations between farmers and advisers. As for other intangible services, relations are thus at the core of advisory services such as agricultural extension: “*advisory can be considered as a relational activity by excellence: the relation made service*” (Gadrey 1994). Nevertheless, there are two kinds of activities within advisory services: back-office activities and front-office activities (following the definition of Chase 1978). Front-office activities are activities realised directly with the client: they consist in the service relations themselves. Back-office activities stand for all other activities which are not realised directly at the interface with the farmers, but which enable to accumulate technological knowledge and to standardize the services supplied to farmers. In the case of extension services, back-office activities consist in field experiments, in the management of data bases, or in administrative tasks.

Applying such an analytic framework to agricultural extension services put under a new spotlight the questions of innovations in these services, as well as the one of the evolution of these innovations.

#### *Innovations and Trajectories of Innovations in Agricultural Extension*

In front of the growing importance of the sectors of services in industrialised countries, different researches had for objectives to understand and describe more accurately the dynamic of innovations in such sectors (Soete and Miozzo 1990, 2001, Gallouj 1994, Gallouj and Gallouj 1996, Djellal and Gallouj 2002, Barras 1986, Sundbo 1998, Howells and *al.* 2003, Hipp and Grupp 2005).

The first question in these researches was to determine whether there exist specific innovations within sectors of services. One of the main economic researches about the characterisation of innovations was the one realised by Pavitt (1984). He produced a classification that was based on the analysis of a data base about two thousands innovations over three decades in the United Kingdom. The criteria used to build this taxonomy were variables such as the source of technologies, the nature of their usage and appropriation, the size of the firms, etc. Nevertheless, in this taxonomy, the innovations in the sectors of services were reduced to the integration in services of technologies produced by industries. Even though the integration of such technologies is clearly a major component of innovations within services (OECD 1999, Amable and Palombarini 1998), other researchers have progressively argued that there exist specific innovations to services (Barras 1986, Soete and Mioso 1990, Hipp and Grupp 2005). This idea is based on qualitative investigations in different sector of services: consulting (Gallouj 1991, 1995), banking (Barras 1990), material services (Sundbo 1996), transport (Djellal 1998), cleaning services (Djellal 1998).

One of the main advances of such researches was to analyse more deeply the relations of services between suppliers and beneficiaries. In that respect, Gadrey (1991) and then Gallouj (1999) have proposed a functional decomposition of the service relation. Gallouj (1999) has identified four kinds of operations within the service relations: material operations, operations of information management, operation of knowledge production or treatment (methodological operations) and relational operations. Each of these operations can be the support of innovations. Our idea is to test whether such a taxonomy of innovations, which have been partly consolidated from observations in different sectors of intangible services such as consulting, could be relevant for agricultural extension.

Extension supplies technical and human capabilities (C) to farmers through service relations (S), in order to support technical changes at farm level.

A first type of innovation is thus an innovation ahead of the service relation itself: innovations based on the renewal of the competences and of capabilities of advisers [ $\Delta C(S)$ ]. These competences can be linked to scientific knowledge (agronomic research), to technologies (agricultural machinery, varieties and chemical products, etc.), or to farmers' practices. Through the training of advisers or through the recruiting of new advisers, service companies can thus innovate by updating the skills and capabilities of their staff.

Nevertheless, other innovations exist, which are specific services. Each of the four kinds of operations that compose the service relation can lead to innovations (*cf.* figure 2.).

There can be innovations in logistic and material operations [M]. These innovations [ $\Delta M(S)$ ] could correspond to an increasing mechanisation of services or to economies of scale. In the case of agricultural extension, such innovations are rather restricted. They could be innovations in the transports or location of the advisers, in order to optimize the time allocated by advisers to transports.

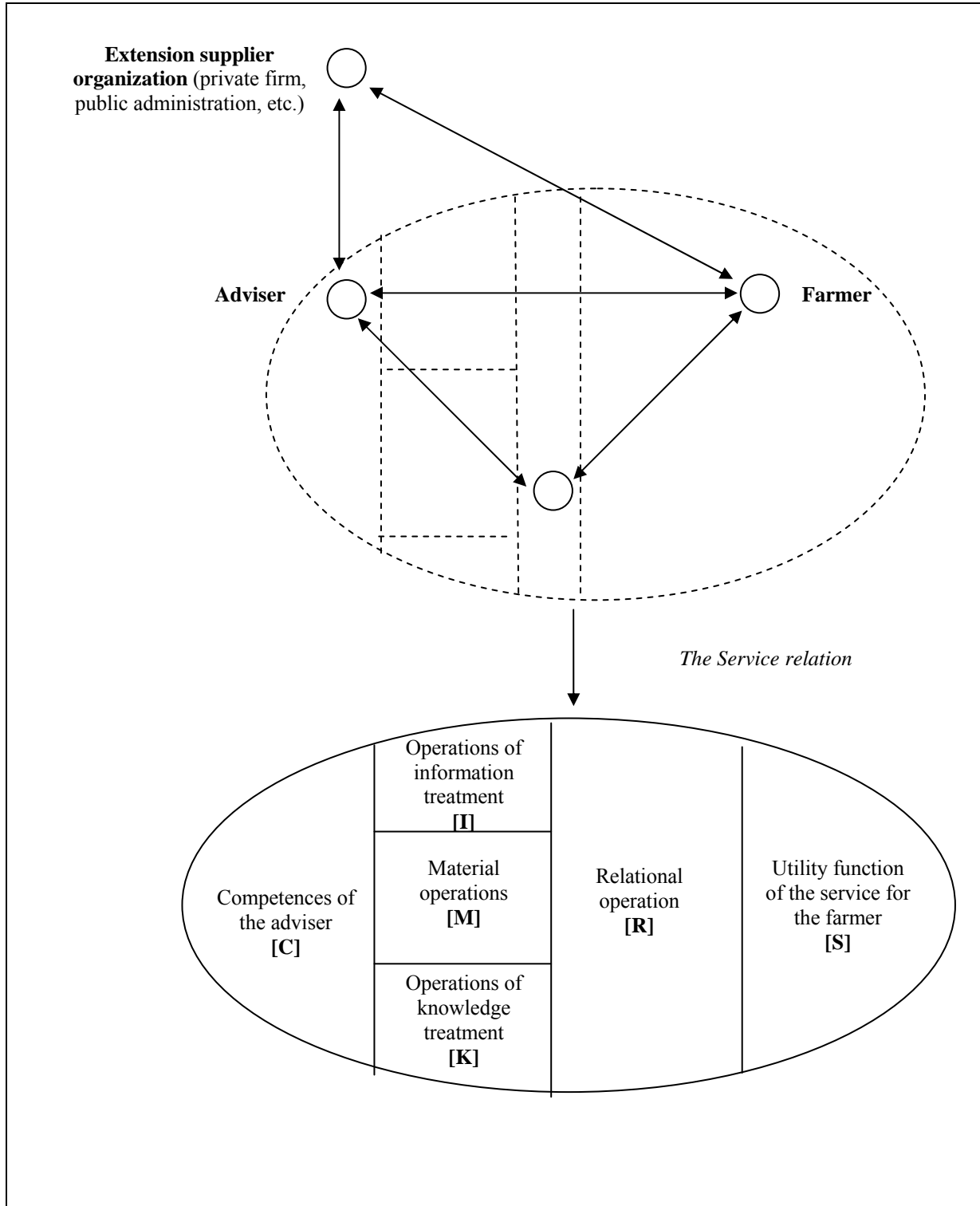


Figure 2. The functional decomposition (M, K, I, R) between the competences (C) and the utility function of the farmer (S), from Gallouj (1999).

About informational operations [I], there can be some innovations [ $\Delta I(S)$ ] that correspond to the reduction in the cost for the production and for the communication of information. Wolf

and *al.* (2001) have shown in the case of economic information that information derive from the application of conceptual models to sets of data. The information can then be exchanged and diffused according to different canals of communication. Thus, there can be innovations both on the procedures for data computing and for the generation of information, as well as on the canals used to diffuse the information. As far as agricultural extension is concerned, such innovations can be embodied respectively i) in the emergence of the use of agronomic modelling software and of data management software aimed at producing information about farming practices, ii) in the technologies used to transfer these information to farmers (fax, Internet, software, etc.).

Intangible services such as extension services also imply some methodological operations of knowledge production [K]. Related innovations [ $\Delta K(S)$ ] can consist in new methods of experiments and or in new methods for connecting experimental units and advisers (creation of technical reference bases for advisers, new procedures for collective identification of problems and solutions through exchange procedures between advisers, etc). In shorts, methodological innovations are innovations in the procedures aimed at improving the effectiveness of the linkages between the actions for the validation of agronomic innovative practices (experiments, etc.) and the front-office activities. These innovations are organizational innovations.

A fourth kind of operations consist in relational operations [R]. Extension services are an intangible service for which relations between farmers and advisers are at the core of the process of the service production itself. Thus, there can be some innovations [ $\Delta R(S)$ ] associated to the interface between advisers and farmers: intensification of the frequency or the duration of the direct exchanges between farmers and advisers, choice between individual, group or mass reunions for the modalities of the relations between farmers and advisers, etc.

This taxonomy of innovations has been identified in different sectors of services thanks to empirical analyses. Gallouj and Weinstein (1997) stressed the fact that different kinds of innovations can exist simultaneously within a sector of a service or within a firm of services. Nevertheless, two hypotheses can be assessed. Firstly, within firms or even national sector intangible services, some dominant types of innovations can exist for a period of time. Innovation configurations are these combinations of the types of services' innovations prevailing during a certain period of time. Secondly, it can be thought that a configuration of services' innovations in a certain period of time can determine the configuration of innovations in the following period of time. Thus, path-dependency can exist and design services' innovation trajectories, which can be defined as a succession of innovation configurations across different periods of time.

Gallouj (1999) tested this idea in different sectors of services, and more particularly in the sector of consulting services for industrial companies. For this specific sector, he identified the following trajectory.

$$\Delta C(S) \rightarrow [\Delta C(S) + \Delta K(S)] \rightarrow [\Delta C(S) + \Delta K(S) + \Delta I(S)] .$$

This trajectory could be described as a sedimentary trajectory, where new innovations are added to former one in each new configuration of innovation. This trajectory describes the growing importance of methodological innovations in the treatment of knowledge and then of informational innovations in consultancy services that were formerly essentially based on innovations in the competences and in the expertise of advisers.

In order to test the heuristic value of this conceptualisation for the analysis of the technological transformations of extension services, we applied it to the case of the evolution of

extension services in three countries: France, the Netherlands, and Germany, from 1945 until now. These three situations offer a great diversity in terms of systems of agricultural extension, but also in terms of recent evolution of these systems. In France, one of the main suppliers of agricultural extension are since the 1960s the chambers of agriculture. Services, goals, management, and financial support of chambers of agriculture have deeply changed in the last decades. The Netherlands are an emblematic country for commercialisation of technical agricultural extension in Europe. In almost every new German Länder, agricultural extension has been commercialised and privatised in the 1990s in the context of German reunification.

Building the research on a comparison between these three countries is interesting, as there seems to exist singular paths for technical agricultural systems which have evolved in different social contexts. The details of the methodology can be found in Labarthe (2006).

### Results and Conclusions

The results show that the technical evolution of extension services has been quite similar in France, Germany, and the Netherlands since 1945. In the three countries, the evolution of technical extension for agriculture follows a long-term innovation trajectory that can be described as follows:

$$\begin{array}{ccccc} \Delta C(S) & \rightarrow & \Delta R(S) + \Delta C(S) + \Delta K(S) & \rightarrow & \Delta R(S) + \Delta C(S) + \Delta K(S) + \Delta I(S). \\ \text{[period P.1]} & & \text{[period P.2]} & & \text{[period P.3]} \end{array}$$

In France, the Netherlands, and Germany, extension services were created during the XIX<sup>th</sup> century. At that time [period P.1], innovations in agricultural extension were mainly based on the competences of advisers. The configuration of innovation was thus restricted to  $[\Delta C(S)]$ . Before WWII, advisers were mainly school teachers who provided farmers – for instance in evening classes – with their competencies about the basic factors of the modernization of agriculture.

During the post Second World War decades [period P.2], a new configuration of innovation was settled in France, Germany, and the Netherlands, at a time when agricultural extension services were delivered by public organizations. Two new categories of innovations emerged. The first one consists of relational innovations. In the three countries, a new interface was created to put in relations farmers and advisers: the circles of farmers. These circles were local groups of farmers who exchanged their views and compared their practices and the performance of their farms about different technical topics. In that respect, these groups of farmers benefited from the assistance of advisers. It is important to notice that there had been an intensification of the means available for farmers at that time. Thus, the ratio [number of farmers / number of advisers] decreased sharply and faster than the number of farmers itself. A second major innovation within extension services during these decades was an innovation in the methods of production and treatment of knowledge in extension organizations. These methods were mainly embodied in new relations between extension services and applied research institutes. Two concrete illustrations of these relations can be given. i) The co-management of experimental stations by advisers and researchers enabled the identification of possible solutions for the intensification and the specialisation of production systems at farm level. ii) The large number of joint agronomic publications between advisers and researchers contributed to the accumulation of technical knowledge. Thus, during post WWII decades, the configuration of innovations in agricultural extension can be written as:  $[\Delta C(S) + \Delta R(S) + \Delta K(S)]$ .

Combined to innovations linked to NTIC and to the rise of agronomic modelling, this configuration of innovation has allowed (period P.3) new innovations to emerge in the 2000s. They are innovations in the way extension suppliers manage technical information both for the farmers and for their advisers. This is particularly embodied in the intensive use of modelling software and of NTIC in the technical extension services. In parallel, there are still innovations in the competences of advisers (who are today mainly engineers), and in the methods for the production of knowledge, with for instance the creation of regional platforms of experimentations, or with the settlement of knowledge brokers, which aim is to re-create links within local agricultural knowledge systems (Klerkx and Leeuwis 2006a, Klerkx and Leeuwis 2006a 2006b.). There are still nowadays also relational innovations, which consist in a trend of individualisation and of personalization of services, associated to their commercialisation. Thus, in the years 2000s, the configuration of innovation of the agricultural extension services can be described as  $[\Delta C(S) + \Delta R(S) + \Delta K(S) + \Delta I(S)]$ .

In conclusion, the trajectory highlighted for agricultural extension services in France, Germany, and the Netherlands for the period 1945-1990 is quite similar to the one established by Gallouj (1999) for consultancy services cabinets advising industrial companies. It consists in a sedimentary trajectory of innovations. The increase in the performance of services was first based only on the amelioration of the competences of the advisers. Besides this, some other forms of innovations gradually appeared: relational innovations (creation of circles of farmers, individualisation of services), and then methodological innovations embodied in collective procedures for the accumulation of technical knowledge that led to important information flows and to informational innovations.

Thus, our analyse shows that the advances in the *theory of services economics* enable to better understand the innovations and the dynamics of innovations in intangible services such as agricultural extension. This work opens new perspectives, but has limits that appeal for new researches to be carried. The first limit is that this work remains qualitative. Some efforts should be carried out to build data bases that could enable to characterise more precisely the innovations of today's extension services suppliers. Such an effort for the construction of data base could also be a first step for the evaluation of the effects of these innovations.

Nevertheless, in that respect, it would be important to take into account the political and social context of each national situation. Some authors thus argue that it is not possible to assess the transformation of agricultural extension services only from a technical point of view, as the institutional arrangements between the state and the farmers' associations could have some effects on the technical changes within advisory services, and on the effectiveness of these changes (Labarthe 2005, Labarthe forthcoming).

### **Educational Importance and Applications**

The conceptualization of agricultural extension as a service activity aimed at the co-production of knowledge has a promising heuristic value for describing its transformations, and could be more integrated in studies and teaching about agricultural R&D. It is necessary to carry on some research investigations about innovations in agricultural extension, by applying the outcomes of the theory of the service economics. In that respect, it seems promising to build research programs including comparative dimensions: comparison between different national or regional contexts of evolution of agricultural extension, or comparisons between agricultural extension and other sectors of services apart from the agricultural sector.

### **Appendix 1: Services and Service Relations, Some Definitions.**

The concept of service relation was first created by Goffman (1968). Based on observations in hospitals, Goffman showed that the relations between doctors and patients can not be reduced to an exchange of information between them. These relations are personalised, enable the co-production of new knowledge, and also imply the building of trust. He describes a three poles relation between a supplier, a beneficiary and the object of the service. He observed that these relations follow four parts: observation, diagnostic, prescription, and treatment. Furthermore, he identified three parts in this relation: a technical part, a contractual part, and a “civility” part. On this basis, extending his observations to other sectors of services, Goffman could classify the different service relations according to the involvement of the beneficiary: from automatic technical services (for example: a service of automatic car washing) to services implying the access to a competence that the beneficiary can not get on his own (for example a consultation by a doctor).

Later, Hill has put the relation at the centre of the activities of services. Confronted to the heterogeneity and to the difficulties faced by different national accountancy systems for taking into account service activities and sectors, Hill proposed the following definition: “*a service can be defined as the transformation of the condition of a person or of a good belonging to a person or to an economic unit, as a result of the activity of another economic agent, with the agreement of the first economic entity*”. Stanback (1979) insisted as well on the fact that services do not exist independently from their beneficiaries, and can not be stored. In that respect, Delaunay and Gadrey (1987) proposed the following definition of services: “*a service activity as an operation aimed at transforming a reality C possessed or used by a consumer (or client or user) B, realised by a supplier A at the request of B, and often in relation with him, but that does not lead to the production of a good that can circulate economically independently from its support C*” (Gadrey 1992, p. 171). Lately, Gadrey and Hill proposed new definitions of activities of services at the beginning of the 2000s. According to Hill (2000), five conditions are necessary in order to describe an activity as a service activity: i) a service differs from an entity, ii) a service implies a form of relation between a supplier and a beneficiary, iii) a service has for object an entity C, iv) the product S of the service is a modification of the entity C, v) no property right can be associated to this product: there is no possibility to sell S independently from C.

For Hill, among these characteristics, the relation between a supplier and a beneficiary is essential in order to segregate activities of services from activities of production of goods: “*the production of services implies a relation between two (or more) economic units, and it is the existence or the absence of existence of such a relation that could determine if an activity leads to the existence of a good or to a service, more than the activity itself*” (Hill 1999). Gadrey nevertheless objects that relations are not specific to services. He proposes for a definition of services the following: “*there is a production of services in two cases:*  
*a) when an organization A, that possesses or controls a technical and human capability [...] sells to an economic agent B the right to use this capability or these competences for a certain period of time, in order to produce useful effects for the agent B himself, or for goods C that B possesses or controls*” (Gadrey 1999, pp. 24-25).

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