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An Ethno-linguistic Approach to the Role of Services in Knowledge Transfer: The Case of the Innovation Relay Centre of Southern Italy[1]

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Abstract *Given the recent resurgence of interest in the economics of language, this paper develops an original model addressing the issue of services role in knowledge transfer by merging economic literature regarding services and technology transfer with linguistic and semiotic theories. The heuristic virtues of the model are then tested by analyzing the case of the Innovation Relay Centre (IRC) of the Apulian region in Southern Italy. This choice was due both to the strong presence in the region of small and medium sized enterprises, and to the well known lack of social capital among local firms. The model has proved to be effective in explaining IRC activity. Moreover it has allowed for the identification of strengths and weaknesses which could be useful for the elaboration of future innovation policies.*

Keywords: Apulian region; economics of language; Innovation Relay Centre; linguistic and semiotic theories; services; technology transfer.

1. Introduction

In the last decades knowledge has increasingly become a central issue in economic analysis, both with respect to conditions leading to its production, distribution and diffusion, and with respect to its impacts on the economics of information and uncertainty. Within the former strand of analysis, the seminal contribution by Fritz Machlup can surely be cited as one of the first works developing an 'Economics of knowledge'. Though it remains a fundamental piece, there is something surprising in his approach, which in a sense has long shaped the economic analysis of knowledge. In Chapter VI of his book, titled 'The media of communication', he states:

> In this chapter we shall talk about books and pamphlets, periodicals and newspapers, the stage and the cinema, radio and television, telephone and telegraph, the postal service, and a few other industries engaged in the

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> distribution of knowledge. All these are ordinarily included under the heading […] 'communications', meaning the conveying of knowledge from person to person, or to masses of persons in the case of 'mass media'.[2]

What is surprising in this chapter is the fact that the author seems to forget 'the most developed and most fully studied system of communication within human organizations: the language, spoken or written'.[3] Language has long been a neglected territory in economic analysis, even in those areas in which this factor can display the most disruptive explanatory power.[4] The progressive emergence of an 'Economics of Language' witnesses an increasing interest for the study of language within economics. Actually, starting from the contribution of Marschak,[5] different scholars coped with this issue. By the way, using the distinction he proposed between the 'normative' and the 'explanatory' branches of communication economics, the contributions that can be included under the heading 'Economics of Language' seem so far to have been biased toward the latter approach. This is to say that most frequently the relationship from economics to language has been privileged, trying to understand and to explain language as the object of a choice. But an endogeneity problem seems to arise, an econometrician would say. Actually, the relationship between the two fields works the other way round, as well. In this work we try to view language as a social technology,[6] that is as an institution 'useful for analysis of factors molding economic performance'.[7]

The fact that language can be useful for the understanding of economic activity is not new to economic literature. Kenneth Arrow emphasized the role of codes in the transmission of information within and across the boundaries of organizations.[8] The sharing of communication codes, whether in the sense of natural languages or sub-codes, is important for the exchange of information, which in turn is needed to combat a primary source of market failure, which is uncertainty. The development of a communication code can be regarded as an irreversible investment, and idiosyncratic in many respects. Thus it is embedded in the historical and geographical contexts of activity. Moreover, as the scale of activity increases, the degree of task specialization within the organization increases. This leads to the development of specific communication codes, related to the different activities that individuals carry on. While there is a greater number of information sources to be pooled, communication becomes more costly because of code differences.

Communication and knowledge exchange are specific tasks an organization has to cope with, to feed the process of knowledge creation. This process is cumulative, and new knowledge emerges as the result of a collective effort. Communication in turn is far from being costless. Knowledge is sticky in that it is very idiosyncratic to the production context. Effective communication hence requires some efforts by the involved parties, and the development of skills and competencies to ease the absorption of external knowledge. Dynamic increasing returns from reiterate interactions are hence likely to emerge.[9]

The aim of the paper is to investigate the way in which technology gatekeepers may ease the process of knowledge transfer among different kinds of organization. We adopt the seminal model of communication proposed by Roman Jakobson in 1960 as an interpretative framework. Drawing on it, the case of the Innovation Relay Centre (IRC) IRIDE (Innovation and Research for Industrial Development of European Enterprises), localized in Southern Italy, has been studied. We carried out a clinical analysis of its activities and performance fostering technology transfer

agreements. We eventually identified six classes of activities that knowledge-intensive business services (KIBS) perform in the knowledge transfer process.

The paper is organized as follows: Section 2 presents the theoretical background within which we develop our analysis; Section 3, after reviewing a selection of technology transfer models elaborates a communication model of knowledge transfer; in Section 4 the working hypotheses are specified; Section 5 presents the case study analysis and the elaboration of an ideal-type sequence of activity; and finally, in Section 6, we outline the main conclusions as well as the possible avenues for future research.

2. Knowledge-based Economics, Technology Transfer and Services Role

Before going on, it is important to clarify the distinction between knowledge and information. By the latter we essentially mean data and concrete facts, which are independent of any interpretation effort. Knowledge is a particular mental representation of information, within a specific context of interpretation.[10]

The production of technological knowledge emerges as the result of a cumulative process, shaped by vertical and horizontal indivisibilities. The different faces of learning are primary sources of new knowledge, which display a high degree of embeddedness within the context of activity. In view of this, firms' search process, far from being random, is likely to be bounded by a multidimensional corridor which characterizes the localized nature of technological knowledge. The effective access to external knowledge is constrained by the absorptive capacity that firms actually possess, due to the relevance of knowledge complementarities. It follows that time and space in which the search process starts do matter, since it can shape the subsequent activity of exploration through the definition of a space in which it is more likely that the firm will proceed.[11]

Different definitions of technology transfer have been proposed so far, as well as different approaches to its analysis. On the one hand, the process of technology transfer has been defined as being the flow of know-how, technological knowledge or technologies from one organizational unit to another; on the other hand it is conceived as the process of technology's movement from external sources towards the organization.[12] The object of the transfer is multidimensional, being either disembodied knowledge, highly codified by means of a patent application or embedded in the specific and idiosyncratic context of production, or knowledge embodied in machinery or goods with high technology content. As Amesse and Cohendet pointed out, the grafting of technology transfer analysis into the knowledge-based approach calls for the adoption of a new perspective. Technology transfer is to be considered as a knowledge transfer process.[13] Once the distinction between knowledge and information is appreciated, it becomes clear that what really flows are mental representations of knowledge, which are codified as pieces of information, which in turn are eventually decodified by the receiver. The way people codify their own knowledge gains relevance in this perspective. The code they use to pack and unpack knowledge matters in assessing the success likelihood of a specific process of knowledge transfer, and hence a greater concern about its idiosyncratic features can help such a transmission process.

Intermediary institutions like KIBS have a crucial role to play in the process of technology transfer, above all in contexts characterized by a high density of small and medium sized enterprises (SMEs).[14] KIBS are users, producers and carriers of innovation that play an interface role between generic knowledge produced

elsewhere and the specific conditions in which recipient organizations operate. Moreover knowledge is a leaky phenomenon, and the exchange of bits distributed and dispersed among the economic agents requires a high level of trust and reciprocity. Thus KIBS may represent a useful governance mechanism enabling markets for knowledge to function.[15]

3. A Communication Perspective on Knowledge Transfer

A communication perspective has been already elaborated in a few models, which deal with the transfer of knowledge within and between firms as well as between firms and public research organizations. What follows is a selected review of models representative of the main trends of analysis.

Malik presented a model of technology transfer management within the boundaries of a multinational company. By focusing the analysis upon the sender, the recipient, the message and the channel, some typologies of 'likely to help' and 'likely to inhibit' factors were found. The former consist of the *market pull* factor; *willingness to transfer staff*, i.e. the existence of a culture of trust; *good listening and communication skills* and *familiarity with technology*. The latter consist of *no interest in a project*, *'not invented here' syndrome*, *language barriers* and *lack of incentives*.[16]

Lin and Berg elaborated a theoretical model in order to understand the factors influencing the performance of international technology transfer projects. In their work they investigate factors related to the nature of technology, i.e. *complexity*, *maturity* and *codification*, the international experience of the agents involved and the cultural differences.[17]

Putranto *et al.* proposed a model of international technology transfer from the viewpoint of the technology receiver. They drew up a linear model made up of three sequential stages: preparation, production and operation. Finally, the evaluation stage gives rise to a feedback loop in the process, generating knowledge and understanding about the technology in operation. Their work can be included in the widespread strand of literature concerning technology transfer from developed to developing countries.[18]

Amesse and Cohendet elaborated a model of knowledge transfer in a knowledge based approach. They identify as key variables the *focus of knowledge* and the *distance from the core* competencies of the firm. Firms decide the organizational asset of knowledge outsourcing according to knowledge scope of application and the proximity to the core.[19]

Bessant and Rush investigated the role of consultants in an interactive and client-oriented model of technology transfer. They identify four typologies of activity that consultants may carry on; *direct transfer* of specialized and expert knowledge produced elsewhere, *experience sharing*, *marriage broker*, providing clients with the contact able to solve their problems, and *diagnostic role*, i.e. the making of clients' needs explicit.[20]

Such models are strictly focused upon the agents involved in the knowledge transfer process, i.e. firms or technology consultants. What emerges is a lack of models with a systemic view on the communication process underlying knowledge transfer, within the broader framework of the knowledge-based economy. The main weakness that can be found in these models is the mono-directional character of technology flow. The emphasis on the communication process makes it possible to appreciate the bidirectional and interactive character of knowledge exchange, which can be easily integrated in the concept of interactive learning.[21]

The assumption of a mono-directional technology flow sounds like the individuals' perfect rationality hypothesis in neoclassical microeconomics. It is too restrictive and implausible. Each communication process implies a bidirectional message flow, so as the distinction between sender and recipient is continuously redefined. The addresser sends the message that is processed and interpreted by the addressee; the receiver in turn elaborates a feedback and becomes itself the sender of a new message, and so on until the end of the communication process.[22] The concept itself of technology/knowledge transfer is questioned here. The use of the term *knowledge exchange* would be more appropriate since each party increases its knowledge stock at the end of the process.

From the foregoing discussion it follows that firms are not seen here as a bundle of contracts. The idea of the firm underlying this work is that of learning agents, repositories of know-how and capabilities allowing them to handle the stock and flow of knowledge within and across their boundaries, and to transform knowledge in economically valuable products or services. Firms are not monads 'without doors and windows', but they are tied by patterns of cooperation and affiliation, out of which one can also found the exchange of knowledge.[23]

In view of this, a knowledge-based perspective calls for the adoption of concepts belonging to different disciplinary fields. Knowledge production is actually a cumulative and interactive process, in which communication among economic agents is the basic element.[24]

The Quest for a Multidisciplinary Approach

Cross-fertilizations are quite frequent in the advancement of scientific knowledge. Popper, for example, explicitly invoked the influence of Darwinist theory in his approach to scientific discoveries. Breaking down the Galilean method, he stated that theories should be subjected to a 'natural' selection by means of falsification rather than be verified (literally *verum facere*, i.e. to make true). An ideal example in the economics of innovation may be found in the grafting of biology concepts into economic analysis, such as in the epidemic model of innovation diffusion.[25]

Starting from Polanyi's distinction between tacit and codified knowledge, a major distinction between articulated and unarticulated knowledge can be introduced. There may be knowledge that is potentially codifiable, but whose codification requires an effort that is not profitable. In this direction 'knowledge is codified (sometime, somewhere) but not articulated (now, here)'.[26] Information flows imply codification and decodification efforts, and hence the issue of intelligibility. Unintelligibility may derive not only from differences in the natural language, but also from differences in its use. We can grammatically understand someone's language, but we cannot understand the real message content because of the inability to grasp the set of norms ruling language use.[27] Different kinds of tacit knowledge can be thus defined, according to different awareness levels, which are very relevant in investigating linguistic and semiotic determinants of new knowledge creation. Such an approach gives new strength to the concept of absorptive capacity.[28] Actually ethno-linguistics investigates the social process by means of which communities build their communication codes and symbolic systems. So the focus of the analysis may shift to the organizational form that is intermediate to market and hierarchies, that is, the *organized market*.[29] Therefore, the ethno-linguistic approach can give new insights into the analysis of the

geographical concentration of knowledge production activities as well as of the conditions that make geographically dispersed interactions difficult.

An Overview of Jakobson's Model

Our starting point is the communication model proposed by Roman Jakobson. He argued that in every communication act there should be at least six factors; the addresser, the addressee, the message, the contact, the code and the context. A function or a class of functions is associated with each factor. If a message is aimed at emphasizing sender feelings then it has an *emotive function*. A message aimed at providing information about the specific external reality has a *referential function*. One aimed at causing a recipient's reaction has a *conative function*. If the goal is verifying the communication channel or the physical and psychological contact then the message has a *phatic function*. If the message has the purpose of emphasizing the potentiality of the message itself then it has a *poetic function*. If it has the purpose of specifying code features then it has a *metalingual function* (see Figure 1).[30]

The concept of code refers to the broader set of rules belonging to the *langue* possessed by individuals of a community.[31] Speech communities are defined by the sharing of both language and the rules for using it, emerging as the result of a convention, i.e. of an arbitrary process. Language is then a function of the real use, so that the reiterate occurrence of communicative behaviours gives rise to a rule. These rules are inter-subjectively acknowledged, entering in the tacit knowledge store that makes intelligibility possible.

This is true not only for the rules of language use, but also for individuals' *encyclopaedia*, that is, the universal symbolic reference allowing individuals to generate meaning.[32] Conversely, the encyclopaedia provides individuals with the categories that are necessary to understand the sender's message. Such universal symbolic reference is in turn the result of a socially shaped process, since it also is the result of an arbitrary process in which habits are basic elements.[33] Semantic structures are community-specific and dependent upon the individual experience, because each

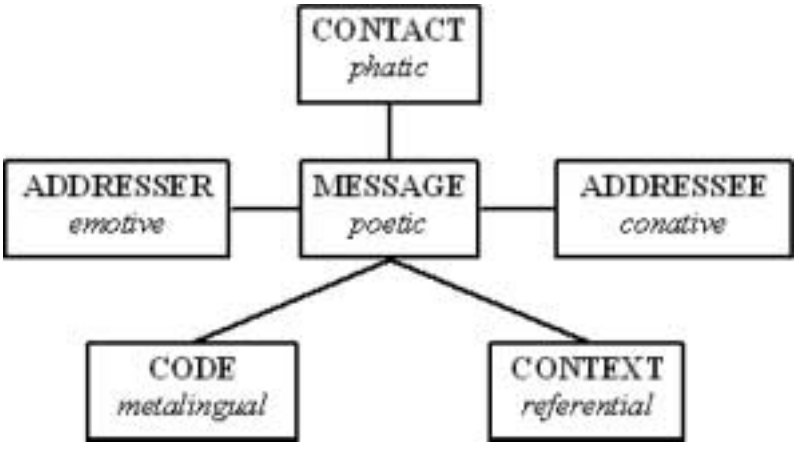

Figure 1. Jakobson's model of communication.
Source: Berruto (1997).

culture makes some distinctions pertinent rather than others.[34] Moreover, from a cognitive perspective, in their comprehension process individuals compare acts (also communication acts) and situations to the set of specific memories stored in their brain *scripts*.[35]

Thus the patterns of cooperation are shaped by the sharing not only of common communication codes, but also historical and contextual experience. Codes in turn are defined at different levels, since they may refer to natural languages or to regional, local or sectoral varieties. Communities sharing knowledge are then characterized by similarity in prior knowledge that makes up individuals' tacit knowledge, which is in turn socially and culturally defined.

In view of this, it follows that path dependence and localization matter also in the process of knowledge exchange and absorption. Economic agents engaging in a cooperative research project with a particular set of partners will be likely to undertake future cooperation activities with the same partners. Dynamic increasing returns stem from the common set of communication norms and rules they already set up, provided they share similar kinds of problems. As the basic communication norms and rules are shared at the geographical level, the knowledge creation process will tend to be clustered in well defined areas, such as technological districts. Knowledge spill-overs are then favoured by physical proximity also because individuals have common codebooks and symbolic capital, defined both at the basic level of the natural language and at the specific level of technological fields. Cultural similarities make misunderstandings more unlikely and enhance absorptive capacities. A geographically localized knowledge production activity emerges as the result of the existence of knowledge that is tacit at the community level. The creation of such a displaced codebook is the result of a time-based activity, representing an irreversible and idiosyncratic investment for the involved agents.

4. Hypotheses

Drawing upon these ideas, we now try and shed a different light on the roles KIBS may play in the knowledge transfer process. The main idea is that services are likely to carry out at least six classes of functions, according to the communication factor they impinge upon.

The *emotive function* is represented by the actions aimed at valorizing the resources of proactive agents. Marketing activities are particularly relevant here as well as long-lasting relations with a stable set of technology suppliers. The *conative function* would conversely consist of technology auditing aimed at identifying strengths and weaknesses as well as fostering the adoption of a specific technological solution by reactive agents.

The *referential function* may be viewed as the providing of both proactive and reactive agents with the information respectively about potential clients' needs and the existing available knowledge. The more complex the knowledge, the greater the number of knowledge sources to be explored. The *poetic function* consists of making the set of knowledge potentialities explicit. Such activity should allow for the fitting of knowledge into the context of utilization, exploring its scope of application and favouring absorbing capacity. The more a knowledge bit is fungible the more it is exploitable.

In performing the *poetic* and *referential* functions, KIBS substitute for firm's competences, defined as problem solving capabilities.[36] They are likely to become

depositories of the 'fourth knowledge layer', that is the knowledge about the localization of knowledge as well as about the incentive mechanisms to knowledge sharing,[37] because of the increasing returns rising from a learning by interacting.

> **Proposition 1**. *The most elementary services KIBS can provide consist of the identification, valorization, exploration and full exploitation of the knowledge owned by proactive and reactive agents.*

We call the *phatic function* the contact preservation among interacting agents. This is mostly relevant when interacting agents belong to different geographical areas, since relationships constantly risk break-up. One can argue that services substitute for the trust and reciprocity effect of proximity. They hence give rise to a network of mediated relationships in which the frequency of interactions influences the creation of a positive climate conducive to knowledge exchange. Moreover communication codes are built up by means of a time-based and resource-consuming process, so that we can observe absorptive capacities to increase at a more than proportional rate with respect to time, because of the twin effect of intelligibility and trust.

> **Proposition 2**. *KIBS are likely to affect the level of social capital among agents exchanging technological knowledge, through the bearing of the responsibility of keeping alive the contact.*

The interface activities between the different communication codes owned by senders and recipients, may be defined as the *metalingual function* of services. A process of knowledge transfer among interacting agents belonging to different geographical areas calls for the correct translation of both knowledge into receivers' code and of receivers' needs into the source language. Such a translation process involves not only a formally correct formulation of the message, but also the knowledge of the broader set of cultural aspects influencing communication and hence intelligibility. The consultants' role consists of both the collection of such cultural factors and effective message packaging (see Table 1).

The emphasis on the *metalingual* function is due to its powerful effects in terms of knowledge exchange. Intermediary organizations may foster the correct expression of clients' technological potentialities and needs as well as the correct understanding and absorption of external knowledge. Indeed firms can be locked in the learning processes that influence their technology choices.[38] When small firms are taken into account, it is worthwhile noting that the lack of managerial and organizational resources plays a major role. Small firms can be embedded not only in the idiosyncratic production process features but also in the specific communication codes they have developed as a result of the interactions in a specific local environment. This lack of linguistic and symbolic competence is likely to reduce the chances of a full exploitation of technology opportunities, whether they are near to firm's core competencies or not.

> **Proposition 3**. *KIBS favour the internalization of external knowledge through the handling of the complex set of cultural and social factors influencing communication effectiveness.*

Therefore, attention to the complex set of factors influencing communication and knowledge intelligibility enhances firms' absorptive capacity. Service activities

Table 1. New taxonomy of services' role in knowledge transfer

Factor	Function	Services role
Addresser	Emotive	Relationships with proactive innovating agents. Marketing activities. Auditing aimed at identifying technological potentialities. Establishment of relationships with a stable set of technology suppliers to which they can refer to.
Addressee	Conative	Relationships with reactive innovating agents. Auditing aimed at identifying technological needs. Stimulus to introduce a specific technological solution.
Message	Poetic	Making explicit the knowledge potentialities set. Fitting knowledge into the context of utilization. Exploring knowledge scope of application. Favouring absorbing capacity.
Context	Referential	Providing proactive agents with the information about the innovation degree of the implemented technology. Providing recipients with the information about the existing available knowledge.
Code	Metalingual	Interface between the different sender's and recipient's communication codes: • Grammatical translation • Use rules • Encyclopaedia Internalization of knowledge spill-overs.
Contact	Phatic	Contact preservation between interacting agents. Lowering transaction costs. Social capital creation.

make it easier for the internalization of knowledge produced in distant geographical as well as technological fields. Hence, we could also expect the role of services to change according to the different sectors in which firms operate, since the forces moulding innovation dynamics are endogenous and should be found in the specific features of technologies.

5. Validating the Model: The Case of the Innovation Relay Centre in Southern Italy

An Overview on Innovation Relay Centres

Innovation Relay Centres constitute a network which was set up by the European Commission in 1995 within the context of the Fourth Framework Programme, as part of the Innovation programme. The latter was aimed at enhancing networking and innovation capabilities of SMEs. Such a network consisted of 53 centres in their first period of activity (1995–98) and of 68 centres in the second period (1998–2002).

The IRC network was established in order to pursue the following aims:

- promoting trans-national transfer of technologies, whatever the origin and according to the local economic, industrial and social needs;
- promoting the dissemination and the exploitation of community research results;
- fostering firms' capacity to adopt new technologies, assessing their needs and ability to take part in trans-national cooperation networks;

- promoting common trans-national innovation initiatives; and
- providing information on innovative activities of Framework Programmes.

IRCs are defined as the regional stepping-stones for the effective implementation of trans-national technology transfer (TTT). They are bridging institutions, belonging to different geographical contexts and working like switching nodes within a structured network.

Their activity is supported by an Extranet which each IRC may access through their website (www.ircnet.lu). It has the structure of a marketplace in which each IRC submits information about their activity, success stories, and brokerage events. The most relevant section consists of the Bulletin Board System (BBS), which is the virtual *locus* in which IRCs promote local innovative technologies and spread local firms' technological needs.

This paper focuses upon the IRC IRIDE operating in four of Southern Italy's regions, i.e. Basilicata, Campania, Molise and Apulia (see Figure 2). IRIDE consists of four organizations gathered into a consortium, each one operating in a single region. They are the Science Park of Tecnopolis CSATA in the Apulian region, Sviluppo Italia (literally 'Italy Development', the national agency for the entrepreneurial development of the *Mezzogiorno*) in Basilicata, the National Agency for New Technologies, Energy and Environment (ENEA) in Molise, and the Agency for Research and Advanced Production (ARPA) in Campania.

The case study analysis was restricted to the activity of the IRC in the Apulian region, which is implemented by the Science Park of Tecnopolis CSATA. Our choice is relevant at least for two reasons. Firstly, the Innovation programme within the Framework Programmes was aimed at fostering the innovative capacity of SMEs. The IRC project, in turn, had the mission of enhancing the diffusion and absorption of technologies within SMEs. In the Apulian production system, 65.9% of firms consist of just the entrepreneur; 26.7% have a number of employees between two and five; 3.64% of firms have between six and nine employees; 2.4%

Figure 2. IRC IRIDE geographical coverage.

have between 10 and 19; 1.05% have between 20 and 49; and only 0.31% have a number of employees between 50 and 249 (see Table 2).

Secondly, firms belonging to the region (Southern Italy, more generally) are described as characterized by a low propensity to cooperation, having a high degree of individualism. Local communities are depicted as characterized by pervasive criminality and absence of civicism.[39] Innovation programmes are aimed at fostering networking, through the creation of social capital among firms. Moreover, since IRC activity concerns the fostering of trans-national technology transfer within SMEs, its analysis can provide useful (counterfactual) evidence for testing the propositions outlined above.

Methodology and Model Validation

The analysis of IRC activity was conducted through a detailed analysis of a wide range of bridging actions that a technology transfer centre may carry out. The analysis was carried out through a *stage* period lasting for a year (November 2000–November 2001). The validity of the model was therefore assessed with regard to each of its components. Moreover, the recursive interactions with the IRC project Director, as well as with local experts, represented a precious knowledge source. The analysis of archive documents allowed us to collect some complementary statistical data on IRC performance, even if in a small number of cases.

Lastly, we submitted a questionnaire to three of the entrepreneurs involved both in successful and in unsuccessful technology transfer processes. After the open-answered questionnaire submission, we processed the information and then we presented the results to the interviewed entrepreneurs for their feedback and comments.

We used as a benchmark the questionnaire elaborated by the European Commission in order to evaluate the effectiveness of IRC activities. The questionnaire was made up of five sections: (1) firms' personal data, (2) actual use of IRC services supporting TTT, (3) actual use of other IRC services, (4) assessment of regional technological capacity and propensity in purchasing IRC services, (5) free comments about IRC activities.

IRIDE was started in 1993 as a Value Relay Centre (VRC) within the context of the Third Framework Programme. It then became an Innovation Relay Centre in 1995 under the Fourth Framework Programme. The Science Park of Tecnopolis

Table 2. Firms and employment in the Apulia region.

	Count	%
1	137,726	65.93
2–5	55,725	26.67
6–9	7,605	3.64
10–19	4,917	2.35
20–49	2,193	1.05
50–249	640	0.31
250–499	61	0.03
500–999	27	0.01
>1,000	11	0.01
Total	208,905	100

Source: ISTAT (1996).

CSATA is the coordinator of the IRIDE consortium. Within the Park's organization chart the IRC's activities are managed by the Innovation and Local Development Department (DISL), which was created in 2000.

The IRIDE activity is characterized by a set of consolidated routines. The first step consists of '*awareness creation*'. IRC spreads information about the technological opportunities existing in the market by means of thematic brokerage events. This is a very preliminary and rough way to establish a relationship with local economic agents. The access to mass media is crucial in this stage as well as the availability of local firms' databases for a broadcast communication. The awareness creation is not very customer-tailored. It is placed both in the *referential* function and in the *conative* function, because of its general content. So IRC tries to stimulate local entrepreneurs in order to cope with widespread passivity of firms. Such an effort is carried out by choosing topical events that are coherent with the regional industrial specialization. They draw firms' attention to technological fields that could be *a priori* of some interest. However, the firms' response to such initiatives is usually quite low.

The establishment of contacts is more effective when it is aimed at finding targeted partners. The BBS provides IRC with the technology requests and offers from the other network nodes. This is likely to give rise to a process of database checking to find organizations that may be interested in a specific technological offer/request (TO/TR). Learning by interacting lowers search costs, as the IRC acquires competence and knowledge about who has or needs a specific technology.

The subsequent and complementary stages are the *technology audit* and *technology watch*. The former consists of a structured interview aimed at analyzing firms' innovation needs as well as at monitoring scientific and technological competences. Moreover, this allows the IRC to quickly identify both the potential customers for a technology offered through the BBS, and the potential suppliers able to satisfy a specific TR. Such a distinction between the supply and the demand side is made clearly pertinent in our model by the distinction between the conative and the emotive function.

Therefore, technology audit allows for the promotion of proactive agents willing to spread their technological knowledge. Moreover, one can assess the needs and the absorptive capacity levels of reactive firms, and identify technological knowledge that may be useful and intelligible. Thus, the relevance of the functions we named as *conative* and *emotive* are evident at this stage.

The technology watch has a twofold purpose. On the demand side it signals whether there are state-of-the-art technologies, able to cope with expressed technology needs. On the supply side it helps in the identification of the innovative degree of implemented technologies. Such an activity, hence, is not aimed at searching for a counterpart for knowledge exchange. IRC provides clients with information about the state of the art, so that we can consider this activity as a kind of *referential* function. It is worth stressing that from the early steps of the process the distinction between activities addressed to the holder and the ones addressed to the recipient were not of great relevance.

The assessment of technological supply and technological needs is a crucial step that is aimed at selecting the feasible projects for cooperation and technology development. An output of this stage may be the undertaking of a communication process among the interactive knowledge-based agents for reaching a technology transfer agreement. An alternative output may be the undertaking of a collective

R&D project in which one of the most relevant issues is represented by the searching for innovation funding.

A complement is the establishment of contacts with reliable partners, by means of the IRC Network. The fact that knowledge exchange process is governed by IRC is a crucial factor lowering transaction costs. Each network node answers on behalf of their clients. A climate of trust is likely to be created and the scope for free riding largely reduced. Such activity is part of the phatic function within our model.

The analysis of the early steps of the IRIDE activity confirms the usefulness of the model we summarized in Table 1. We can observe that the *conative*, *emotive* and *referential* functions have proved to be of particular relevance.

However, carrying out such functions implies the undertaking of several communication processes. To understand clients' technological needs it is necessary to speak with them, and to try occasionally to compose the puzzle of their ideas. The same applies to the identification of technological strengths which are to be exploited in knowledge markets. The *metalingual* function is at the core of these activities and it has proved to be pervasive in all the stages of the process.

Finally the providing of information about state-of-the-art technology and the access to specific bits of knowledge also requires the existence of a high degree of reciprocity with the knowledge sources, since they could have some hesitation about disclosing some information. Therefore, the *phatic* function also appears to have specific relevance.

The analysis of archive documents provided the figures concerning the activities above. As it emerges from Table 3, the narrower the target of communication activities the less the number of outputs. Concerning the Technology Transfer Agreements, three outward TTT agreements and one inward TTT agreement were signed during the observed period.

The steps we described represent necessary ones but they do not suffice. The last step may give rise to negotiations aimed at transferring technology. If this is the case, IRC is likely to play a very important role. Let us investigate it by considering three cases of technology transfer negotiation, one of which has not been successful.

Inside the Knowledge Transfer Process

The first story concerns BioD S.r.l., a small firm created in 1987. BioD's core activities are the production of monoclonal antibodies for flow cytometry applications

Table 3. Main results of the IRC IRIDE activities

	Inward technology transfer		Outward technology transfer	
	2000–2001	**2001–2002**	**2000–2001**	**2001–2002**
Clients contacted	189	92	156	120
Clients assisted	21	54	15	51
Negotiation started	19	4	12	49
Negotiation ended	3	3	–	20
Signed TT agreements	1	1	3	2
TR published/processed	6	2	6	19
TO published/processed	120	3	132	–
Company visits	53	54	22	120

Source: IRC IRIDE Annual Reports (2001 and 2002).

and the research and development for tumour detection and cancer therapy. The production of monoclonal antibodies is strictly related to the presence of a specific machinery, the Flow Cytometer. It is a very expensive piece of hardware and it represents an irreversible and idiosyncratic investment. The market for monoclonal antibodies is characterized by a low degree of competitiveness, in which there is to date a duopoly situation. Such difficulties pushed BioD to find an innovative solution. They looked for partners in order to develop a new product addressed to a niche market. They found a German partner with which they engaged in a joint venture aimed at producing a Flow Cytometer for the detection of chromosomal aberrations.

As argued by the BioD manager, the geographical distance of the German partner made it difficult to preserve their cooperation efforts. IRIDE activity then allowed for the *retaining of the reciprocal linkages* when interactions began intensifying. Hence the role of the *phatic* function has been crucial to developing a pattern of cooperation shaped by trust and openness. The IRC involvement emerges here as a basic factor enabling SMEs to cope with the lack of managerial skills and competence in communication processes with geographically dispersed agents.

The IRC performance was also relevant for the effective comprehension between the two parties: difficulties emerged not only because they spoke different natural languages, but also because of the specificity of the sub-codes characterizing the respective fields of activity. Skills and know-how of IRC's people have proved to be basic elements in the knowledge transfer process. The direct relationship between addresser and addressee is indeed articulated into several relationships. First, each IRC interacts with its own clients. Secondly, IRCs themselves need to interact to make technological needs explicit. The consistency and coherence of IRCs' reception competences are necessary for a good interpretation of the exchanged knowledge.

The need for a correct understanding of clients' sets of cultural, technological and linguistic characteristics influencing communication is addressed by the interface role that services play in the process of knowledge exchange. The *metalingual* function fostered the correct matching among clients' knowledge needs and the knowledge possessed by the counterpart, avoiding misunderstandings that could have jeopardized the communication process.

The categories borrowed from ethnolinguistics hence help the understanding of how this case of technology transfer benefited from IRC intervention. Actually, the exchange of subjective knowledge among two agents needs to be codified in bits of information. As emphasized in Section 3, each code is the outcome of an arbitrary inter-subjective choice, and habits play a fundamental role in setting its shape as well as in moulding its evolution. Explaining geographical clustering of technological activity should also account for the specificities affecting the basic layers underpinning (technological) communication. This perspective also calls attention to the linguistic capabilities characterizing the KIBS involved in the process, since it is supposed to interact with geographically dispersed subjects. In this sense the proper development of such capabilities can help in overcoming at least some of the barriers in the exchange of tacit knowledge among dispersed agents.

The second technology transfer case concerns Durum Italia S.r.l., a company which stemmed from the merger of the 'Mininni' and the 'Capriati&Loiudice' mills located in the small town of Bari, Altamura, which is famous for the peculiar quality of the local bread. Altamura bread has good nutritional properties due to

the base material (the durum wheat semolina) and to the particular way it is processed. Both the knowledge content of the bread production process and its tangibles are basic factors giving rise to such a specific quality. IRIDE processed the technology request by the Irish IRC 'Enterprise Ireland' on behalf of a bakery producer. The latter was looking for new knowledge, which would enable them to diversify their product portfolio and hence, to enter new markets.

The *technology audits* previously carried out within a set of local agro-food firms has proved to be a precious resource. IRC have been able to quickly identify the potentially interested firms having the requested knowledge. Knowledge and competence are confirmed as crucial resources also for the IRC in that the reiterated interactions with local firms allow it to gain the benefits of learning economies and then to increase their effectiveness.

The establishment of profitable cooperation was preceded by the organization of a demonstration session in Altamura on 12 and 13 October 2000. Then the Italian bakers spent a week in Dublin in order to transfer the know-how related to the Altamura bread production process. During their stay in Ireland, the bakers were supported by the IRC staff who provided them with simultaneous translation services and information about the local lifestyle.

However, specific competences are not the only factor determining the bread's particular flavour. The other necessary element is represented by the durum wheat semolina. Thus, tangibles and intangibles are strictly intertwined. There is something like a systemic relationship between these two factors. Hence, knowledge transfer had to be followed by the export of the semolina. This has determined the conclusion of the exchange relationships between the Irish and the Italian bakeries. Transport costs were, in fact, too high and made the investment unprofitable. Scale economies could have been reached only by entering very large markets.

Besides the factors influencing the communication act, the kind of knowledge and its form are pertinent in determining the success of the exchange. So intermediaries' activity may be considered a necessary factor, above all for SMEs geographically dispersed, but sometimes it does not suffice. When disembodied knowledge is linked by complementary and systemic ties to other bits of embodied knowledge, its internalization can be made unprofitable by spatial distance. Transport costs become a variable, out of the ones influencing firm's strategic decisions, which can induce them to concentrate relationships in a well defined geographical area, *ceteris paribus*.

Another relevant aspect emerging from this case study concerns the serendipity of innovation processes. The uncertainty of the output of such a process is one of the key factors enabling the innovating firms to widen the scope of their activities, provided that coordination costs are low and efficiency is high. The recombination of the knowledge embodied in the durum wheat semolina, namely its biological properties, with the local knowledge embodied in the bio-chemical properties of Irish water (which is responsible for the particular taste of Irish beer) gave rise to a new quality of bread with a very specific taste. However, the difficulties represented by transport costs once again discouraged the exploitation of such an outcome.

The story of the Altamura bread underlines the existence of different degrees of complexity, according to the kind of interface role the KIBS is asked to play. This is to say that even when technology is highly codifiable, barriers can still persist and make the flow of information difficult. Besides the technological content of knowledge to be transmitted, here the relevance of language as a system of communication clearly appears as a key factor. It is at the very heart of a communication

process, and it can become a real problem when the set of social and linguistic capabilities characterizing the interacting parties is a lower profile one.

The last case study refers to Tekne S.r.l., which is a small firm settled in Lecce and operating in the mechanical sector. This firm was able to obtain funds for carrying out research and development activities within the context of the national law 46/82. So they undertook a research project aimed at developing an innovative burning system able to produce thermal energy from agricultural biomasses. They focused their efforts upon the burning of olive oil waste. Olive oil production is, in fact, one of the leading economic activities of regional firms.

Their purpose was to produce a small scale burning system, since its potential market chiefly consisted of small agricultural firms. The *technology watch* revealed that it was a very original idea, although there were many difficulties in its implementation. The actual minimum efficiency scale of biomasses burning systems is in fact very large requiring huge investments.

The main problem was in the engineering stage, since there were no similar state-of-the-art implemented technologies. So they needed complementary know-how in order to pursue their aim, and then IRIDE sent on the knowledge request within the IRC Network. First, they found a Dutch firm and then a Slovenian firm that were interested in developing such a technology. In both cases they were not able to finalize their cooperative activity.

The geographical distance played a crucial role in this story, because of the individualism and mistrust of Tekne's manager. He, in fact, feared counterparts' opportunistic behaviour and preferred to find his own solution. Differences in the local markets for technology had a relevant weight. It was difficult to reach an agreement on the scale of the system to be developed. So, the lack of effectiveness in partner finding was due to the inability to carry out what we called the *poetic* function, that is, the adaptation of technologies produced elsewhere to the specific and idiosyncratic features of local product markets.

As emerges from the analysis of the case studies, a recursive sequence of activity may be discerned representing the typical interaction routine that is undertaken by the IRC. It is just heuristic means, thus it can fit reality, but exceptions are allowed.

As shown in Figure 3, the most common function that IRIDE carries out is the *referential*. It emerges in the relevance of the capacity to manage a large amount of information sources, as well as in identifying the right organizations to interact with. The engagement of a communication process is necessary to perform such functions. The *metalingual* and the *phatic* functions have proved to be basic elements in determining the success of the intermediary activity in knowledge exchange.

Moreover, the *phatic* and the *metalingual* functions represent the stages with the higher knowledge content, in which skills and competences are crucial to the successful outcome of the knowledge transfer process. The *poetic* function is, indeed, completely absent. Maybe this is at the origin of the TT failure story. The need for a new small scale technology for biomasses burning required the search for similar technologies to adapt to this specific context of application. However, the lack of the appropriate knowledge base to undertake such a process has also played a role.

Finally, but as importantly, by stressing the relevance of the code, and unveiling the complexity of the distinction between tacit and codified knowledge, it becomes possible to link the role of services to the specific features of technological knowledge to be exchanged.

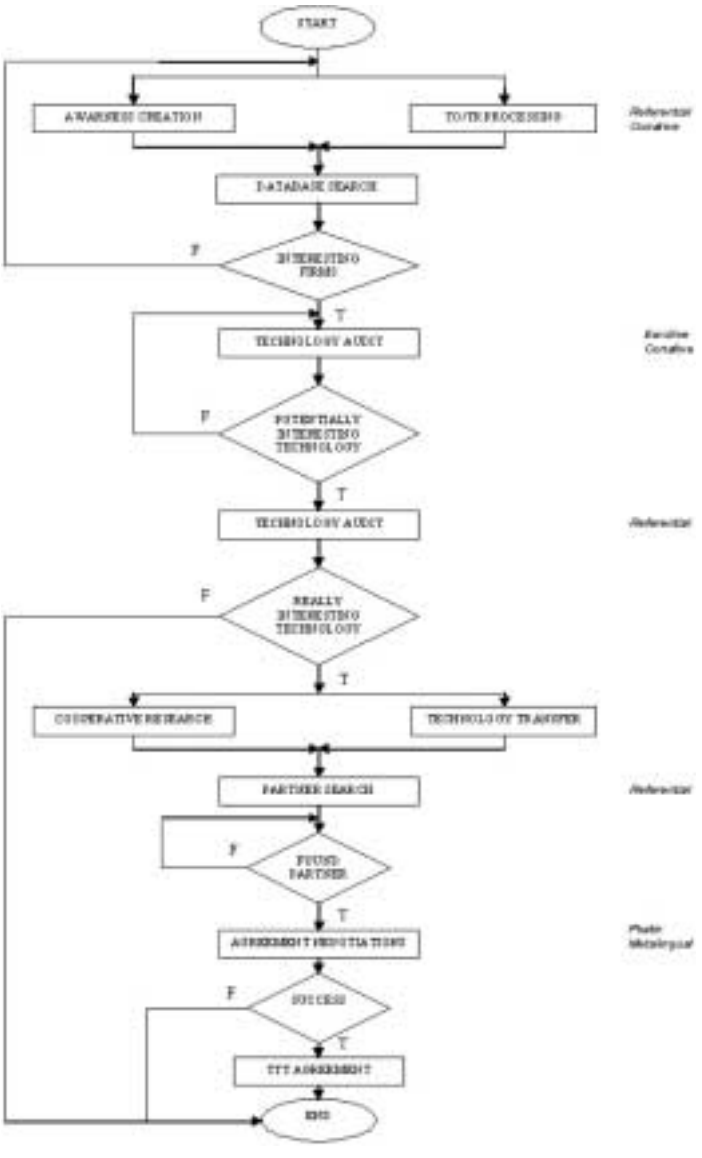

Figure 3. Flow chart representing IRC activity.

In the case of BioD, for example, a mix of both tacit and codified knowledge was at work. The former was related to firms' idiosyncratic capabilities and the second to the new scientific and technological knowledge upon which firms' innovative activities are based. In particular, we stressed the relevance of sub-codes, that makes knowledge spatial boundaries very relevant. Firms were then engaged in a communication process in which the encoding and decoding role of IRCs was necessary. Sub-codes are very specific and idiosyncratic, embedded not only in production conditions in which firms operate, but also in the social and cultural circumstances. The IRC role, in this case, had a more value-added content, since a set of complex factors had to be managed and understood in order to make knowledge exchange successful.

In the case of the Altamura bread the knowledge to be exchanged, albeit embedded in on-the-job learning processes, had a very highly codifiable character, since bakery skills are quite widespread, and they are a part of the knowledge universe of different societies. This also suggests a relationship between the role of services and the stage of the technology life-cycle.[40] As such, the nature of the bakery knowledge base allows for the exchange and the absorption of knowledge, independently of spatial distance. In this direction, IRIDE played a very basic role. Beyond the processing of the technology request and the individualization of the local firm able to satisfy the expressed needs, they just provide a service of translation of the natural language, and no need for the codification and decodification of the necessary capabilities for producing the good. Conversely, in the BioD case the involved organizations operated in sectors situated on the technological frontier. Here, codification is still in its first phases, and communication requires displaced communication codes to be made explicit. Actually, codes are not only geographically specific, but also epistemic-community specific, so an interface to make knowledge flow among communities is necessary.

6. Conclusions

Knowledge production process is a complex task in which external knowledge has a strong influential role. Knowledge flows in different ways, since it may be embodied or disembodied as well as tacit or codified. The process of knowledge exchange, therefore, is a basic element in the knowledge production process.[41]

The issue of technological communication among the innovating agents becomes more and more relevant. Economics does not have the heuristic means to understand the dynamics of communication processes. Matching of the economics of knowledge production with meta-economic disciplinary fields, such as the ethnographic branch of sociolinguistic and semiotics, is necessary.

Communication is a multidimensional process, which is characterized by multiple factors.[42] The appreciation of the factors influencing the communication act allows for the identification of the basic elements that are crucial to the effective knowledge absorption and that are influential to the process of geographical agglomeration of innovation activities.

By linking these factors to specific functions carried out by intermediary organizations like KIBS we have investigated the elements influencing the likelihood of success and failure in knowledge exchange among geographically dispersed innovating agents.

The factors influencing the social process of codes construction have proved to be especially relevant. By codes we mean here both individuals' grammatical competences and the complex set of symbols that make intelligibility possible. The activities aimed at increasing frequency of interactions parallel the interface activities, in that they are likely to induce interacting firms to build up a shared social capital.

The innovative model we proposed in this paper then helps in understanding the dynamics of knowledge communication, drawing upon the ethnographic branch of linguistics and cognitive semiotics. The analysis of IRC IRIDE activity supports the validity of our model and provides us, by contrast, with an overview of the factors that are likely to make the geographical concentration of innovative activities more effective.

Technological communication is difficult above all for small and medium sized enterprises, because of the lack of adequate skills and resources to manage it.

Hence, business services can help SMEs to gain the increasing returns engendered by access to external knowledge. However, the dynamics enabling positive feedbacks to take place are still far from being fully understood.

The model suggests that KIBS can ease the access to external knowledge and the quick identification of partners and the effective absorption of knowledge. Actually, knowledge externalities are likely to display their positive effects if they are correctly understood and if they fit the previous knowledge endowment of the recipient organization. The context of message production as well as reception matters very much.

The first policy implication concerns consistency of services skills with the local production structure. The BioD case was successful because IRC personnel had the necessary know-how to understand its client and the knowledge holder. The complementary issue is the providing of the local economic system with skilled man-power able to interact with consultants as well as to deal with change and new emerging sectors. The education and training institutions are here the chief target of policy actions.[43] They should be pushed to create a local highly qualified labour supply. Actually, such institutions can shape individuals' interpretative categories, influencing the process of knowledge absorption.

The second issue is about geographical distance. Knowledge production has proved to be clustered in a few regional contexts. New information and communication technologies in this direction are not able to fully display their centrifugal power. The services role was relevant in favouring the internalization of knowledge externalities, but it was more difficult to lower transaction costs, as showed in the Tekne case. However, this is due not only to the lack of the firm's associative culture, but also to the lack of common aims to pursue, which cooperative action should have drawn upon. So it is not geographical distance itself that makes technology transfer difficult, but the differences in the local structural conditions that do. Innovations are localized into the specific conditions of the context in which firms operate. Small firms are then likely to introduce contingent technological change also fitting the features of product markets.[44] In our case market conditions for each technological partner were quite different. This calls for more targeted cooperation policies. Trans-national cooperation for innovation should keep firms in contact, involving areas characterized by similar product market conditions, so they could give rise to projects aimed at pursuing common objectives. Social capital then will be likely to be created.

IRC activity could be enhanced by the interplay with future initiatives funded by Structural Funds. Moreover they should be sustained by an accurate and targeted selection of areas and sectors to keep in contact. Innovation produced in one context may prove to be unprofitable for firms belonging to different areas, since the composition effect is likely to neutralize the shift effect. Both market conditions and learning processes in specific technological fields are important.

The multidimensional character of the innovation concept makes the distinction between traditional and high-tech sectors less relevant. In fact, when the scope of technological opportunities is reduced as an effect of the sector lifecycle, product innovation emerges as the rational alternative to process innovation. In this respect the case of the Altamura bread is enlightening. A new variety of bread was the means enabling an Irish firm to enter a new market niche. So innovation policy should favour the exploitation of local resources, although they belong to traditional sectors. On this reasoning, fostering the creation of high-tech industries may prove to be an unsuccessful strategy, at least in the short run.

The grafting of communication concepts onto the economics of innovation has proved to be useful in order to reach a better understanding of the knowledge transfer process. Localization of innovation activities and path dependence find here a further explanation. Hence KIBS can play a key role as policy instruments for knowledge transfer, provided that the set of complementary policy actions so far introduced are put in place.

In view of that, future research should try to investigate more deeply the role of the elements affecting communication among agents, in shaping the patterns of cooperation and the final outcome of the knowledge creation process. We argue that a better account of language and culture may enhance the explanatory power of the literature investigating issues of complexity and fungeability in knowledge production, as well as of literature concerning the regional dimensions of competitive advantage.[45]

Notes and References

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