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Article

The sociological nature of science communication

Luciano d'Andrea, Andrea Declich

The article proposes a reflection on science communication and on the communicative processes characteristic to the production of new-found knowledge. It aims to outline the role that sociology can play within this frame for greater understanding. The article first defines the main evolutionary trends in scientific research in recent decades, with particular reference to the emergence of new social actors. Following on from this, it will look at some of the epistemological conditions that may strengthen the sociologist's role in the cognition of scientific production. Using this as a premise, we will look at a typology for science communication and its components, as well as some of its governing principles. The conclusion of the article indicates the added value that can be gained from the use of such a model, with the particular aim of identifying indicators that allow the evaluation of scientific research in sociological terms as well as those already in existence.

Keywords: Sociology, science communication, social actors.

Introduction

In recent decades, modes and forms of scientific and technological production have undergone profound changes. Indeed, many typical scientific structures, such as the disciplinary organisation of scientific production or the separation between the production of knowledge and its application, have been topics for weighty discussion.

These mutations focus attention not only on the question of the role of communication regarding science within society, but above all demand a closer inspection of communication within science itself**.**

Scientific communities have increased dramatically, developing into ever-growing networks that cross institutional, geographical and disciplinary barriers. As well as this, there scientists' have an increased ability to communicate with each other, due in a large part to greater ease of information exchange through electronic means. This sharing of ideas, facts, hypotheses and solutions takes place at an incredibly high speed**.** This is also because nowadays there is a tendency towards communicating research findings at the same time as they are produced rather than when they have been definitively obtained.[1] It could be said that today, the research process requires a greater division of labour in comparison with the past; this is a factor which is of major relevance from an institutional and organisational point of view, as it brings about the emergence of new roles in scientific communities (not only researchers, but also fund-raisers, trainers, knowledge managers and so on). The increasingly trans-disciplinary nature of research and the growing presence of people who are not members of the research community but who take part in the research process nevertheless – from funding bodies to local administration, from members of the public to opinion-makers – requires the development of new mechanisms of transduction of scientific contents from one discipline to another and from one culture to another, bringing into play all the linguistic, symbolic and rhetorical aspects of human interaction.

There is no doubt that communication has always been considered an integral part of the research process and a guarantee for the scientific validity of its results. It is also true, on the other hand, that currently this communication takes an unedited form, dimension and content,[2] which is still in partial need of interpretation and comprehension. It is important to underline that, in this regard, communication seems central to scientific production itself and not only for understanding its social and economic impact.

The role of sociology in the study of science and technology

Among the many social disciplines that are connected with science and technology, it would seem that the field of sociology is best suited to answering the numerous questions that arise from the situation previously outlined.

Moving beyond the socio-institutional perspective, put forward since the 1940's in pioneering work carried out by Robert K Merton,[3] the route taken by sociology in recent decades has been characterised by a progressive diversification of approaches,[4] each one connected to specific sociological perspectives which often interact with or are complementary to one another. We can mention conflict sociology,[5] systems sociology,[6] feminist sociology,[7] ethno methodology,[8] field theory[9] and finally social constructivism which had as its starting point the "Strong programme in the sociology of knowledge",[10] giving birth to different theoretical strands, such as those seen in Action Network Theory (ANT),[11] Social Construction of Technology (SCOT),[12] or the New Production of Knowledge.[13]

Even in their diversity, these approaches stand out from the norm in that they do not limit their field of study to external social aspects that have an impact on science and technology, nor solely to the impact that scientific and technological developments have on society, but rather they concentrate primarily on the complex processes that go on within the black box of research, including the communicative and relational processes therein.[14]

Although sociology's self-promotion seems therefore totally justifiable through its research tradition in the sectors of science and technology, it is nevertheless weakened by the fact that the field has still not managed to resolve some problems related to its scientific and theoretical status. In this regard, we can mention the difficulties encountered by sociology when dealing with social actors and the cognitive dynamics that ensue; the continuous risk of sociology's sliding towards a merely statistical or excessively philosophical, political or ideological approach; the tendency which is shown in the adoption of epistemological models and theories that are based on an obsolete positivistic vision of natural sciences; the nervous tension which often surrounds the discipline when searching for social legitimacy, not within its own theoretical base or within its own interpretational capability, but rather in offering itself as the basis of social policy and social work.

This is not the forum for a deeper analysis of these aspects, which are the object of a lengthy and complex study carried out by the authors in a research programme in CERFE, a social research institute based in Rome. It is nevertheless useful to point out two possibilities that should be considered in order to tackle these difficulties.

The first consists in giving cogence and greater weight to sociological theory,[15] in the view outlined by Imre Lakatos,[16] not as a system of abstract assertions concerning reality, but rather as a recognition of concrete links between phenomena; above all those that are hidden, unforeseen and unexpected.

In this context, it would also be advisable to take into account the relevance of mid-range theories mentioned by Merton.[17] These are theories which, by virtue of their proximity to an empirical base and their concentration on defined portions of reality, often seem to be more reliable and verifiable than more general theories. The acquisition of a greater awareness of the conventional and instrumental nature of the concepts being used is of notable importance, taking these as prescriptions for which aspects of reality are to be observed and which left aside. All of this has the aim of giving observational power back to theories which they may otherwise risk losing.

It is equally important to turn in the other direction, that which points towards a greater accumulation of sociological knowledge – an accumulation which is rendered particularly difficult due to a marked tendency for sociologists to prescribe to various schools of thought and communicate very little among themselves. Rather than the conflicts and enclosure which characterises them, each theoretical standpoint should be thought of as a bearer of specific examples with regard to views to be prioritised in an analysis of reality, views which are, for most of the time, not only compatible but also complementary.[18]

There is a close link between the two proposed directions, if nothing else than because the accumulation of knowledge (if by knowledge we do not mean mere uninterpreted data) only becomes possible when there are open theoretical systems, more efficient and progressive than their predecessors.

It is worth saying here that theories which have these characteristics are also those which facilitate, speed up and clarify communication, both within and between the sociological discipline and other disciplines.

A sociological perspective of science communication

The aforementioned aspects internal to the discipline of sociology are important to mention in that they can better facilitate an analysis of how to evaluate the specific contribution sociology makes not only to study, but also to the management of communicative processes within science.

The contribution is already very relevant and allows us to gain a deeper insight into the dynamics of communication inside scientific and technological research processes which have become more complex, deeper, faster but also less transparent than in the past.

It is with this in mind that we can attempt to define an elementary model of science communication**.** This attempt arises from sociological research regarding recent changes in the production systems of science and technology as well as the experiences of an institute such as CERFE, which has to deal with the question of communication within its research activities on a daily basis, in particular concerning social sciences.[19]

This model will identify eight different components of communication, all in some way necessary for a scientific organisation to be able to express its maximum potential, favouring a complete and thorough interaction between the different actors involved. The typology presented can be useful not only to be able to isolate the phenomena which are present in scientific communication or to define more conscious and efficient communicative strategies, but also to gain a diverse insight into scientific research whilst carrying it out, as with some impeding or facilitating factors in its development. These are called components in that they combine and merge within a single communicative act. It is useful to underline that this is dealing with the communicative process as if it were taken from the point of view of the researchers. Clearly, this is convention. Indeed, since the communicative process is intrinsic to the process of scientific production, this can be analysed from the viewpoint of any other party involved, attributing also to the latter that which in the text is attributed to researchers.

Before examining the specifics of the proposed model in detail, it is important to briefly mention an aspect which is often overlooked. That is, which characteristics of the involved parties are to be considered relevant in order to analyse communicative processes. In fact, by surreptitiously adopting a naturalistic vision, we tend to take for granted that these are individual human beings or better still concrete organisations, in both cases taken as non-deconstructable units.

The proposed model, on the other hand, is based on an analytical viewpoint of a sociological nature – of the social actor and aims to isolate their salient characteristics. Such a viewpoint comes about as a result of a dual affirmation. The first is that, in every involved party it is always possible to pick out a cognitive dimension (that which includes knowledge, ideas, representations of reality, feelings and so on). The second is that all the efforts made by an operator, be they individual or collective, are pointed in alternate directions, for the construction of being. That is to say either the subject works to establish or reinforce himself (an autocentric behaviour) or conversely to modify external reality (an attitude that we could define as allocentric).[20] This dual opposition allows us to better understand which dimensions of an operator are at play in the communicative process and which attitudes the operator takes in more important situations.

At the same time, this allows us to consider the relevance of two components of the proposed model, vision and representation, which are always present to a greater or lesser extent in every act of scientific communication, this being at the basis of the operator's desire to communicate something. We will take these two elements as a departure for a description of the model.

Representation

The first component of communication surrounds the representation of the communicating subject. The individual researcher, the research group or research institute which activates the communicative process

must necessarily provide information concerning their own characteristics, capabilities, curriculum, objectives and potential, if they require scientific credibility.

Credibility represents a central and constituent element for establishing a trusted contact with interlocutors.[21] The latter tend also to accept the validity of information received from other sources based on the credibility of the subjects, as they rarely have the opportunity to verify the accuracy of procedures used in research activity or the validity of results. This is all the more relevant when the interlocutor does not belong to the research community, but is a funding body, an economic operator, a political body or public opinion as a whole.

In this respect we can interpret the tendency for private institutions to set up their own scientific committees, as is the case with some universities that set up inter-university partnerships or more formal associations.

Vision

Every research activity, whether in a direct or indirect way, takes on significance and is therefore evaluated and interpreted in the light if the vision that it offers of reality, of problems to face, solutions to take on board, the opportunities that are presented and their implications (theoretical, practical, political and so on). This vision contributes to the definition of what is at stake**,** evoked by the research activity which therefore becomes weighted with significance for the researchers that are carrying out the work. According to Teilhard de Chadin, the production of visions founded in reality, and emerging from the apparent disorder of things constitutes the ultimate goal of every scientific activity.[22]

The importance of communicating a vision is all the more valid when dealing with research projects which are yet to begin or which are still to yield results. In these cases, the vision constitutes the promise which anticipates the value of certainty for products and results whose certainty is, in itself impossible to display beforehand. This promise is made in order to raise interest in the scientific community, to obtain funding or to seek the collaboration of other scientists or research institutes**.** Obviously, as the research progresses, the vision which was promised must then be corroborated with the results obtained.

The final six components of the proposed model are defined through the consideration of different types of actors that take part in the communicative relationship within the context of scientific and technological production.

Intra-epistemic communication

Intra-epistemic communication regards the forms of communication implied when researchers deal with their peers; those, therefore, that belong to the same epistemic community because they work in the same disciplinary environment or work in the same research field.

This type of communication is among the most well-known and most studied, also in the field of sociology of science, above all considering the enormous increase in forums for scientific debate and transfer that have arisen over recent years (specialist magazines, conferences, e-journals, electronic communication and so on). It may also be for this reason that nowadays there is still a misplaced tendency to consider solely intra-epistemic communication as relevant in the research process.

Trans-epistemic communication

The expression trans-epistemic[23] refers to that component of scientific communication which deals with subjects who come from diverse disciplines that are involved in the process, more or less alike, often operating as representatives of non-academic institutions.

This type of communication is growing in significance, both for the relevance that trans-disciplinary research projects have assumed and due to the closer relations between universities, companies and public administration.

In particular, it is worth pointing out the importance of trans-epistemic communication from the point of view of scientific innovation. Whilst intra-epistemic communication seems to dominate in the field that Kuhn defines as normal science,[24] trans-epistemic communication seems to be connected to the moments when paradigms breakdown,[25] moments characterised by the identification of new and often unexpected associations of diverse phenomena.[26]

From a sociological point of view, the huge heuristic potential of trans-epistemic communication can be seen in the possibilities that it can bring for anchoring together transmitters of knowledge that would not otherwise communicate, opening the road to theoretical solutions – which are often initially formalised in analogical terms – that are highly creative.

The greater the distance between these knowledge providers, the more abstract the plan of discourse wherein their communication will take place. In the same way, disciplines which are closer to one another will move in a weak trans-epistemic communicative forum, of a multi-disciplinary nature. We can consider, for example, the use of sociological categories in economic theory by authors such as R. Coase, D. North, A. Sen and J. Stiglitz. On the contrary, more distant disciplines will tend to produce a strong trans-epistemic communication, which functions above all in an epistemological dimension or at the level of abstract theoretical models. Here we can cite the impact that the notion of the fight for survival borrowed from the work of Malthus,[27] an economist, has had in the field of evolutionary biology, or the reference made by neoclassical economists to concepts taken from theoretical physics.[28]

Social communication

The fifth component of science communication is represented by social communication, where social groups, social factions, civilian organisations and many actors of varied denominations that are interested in determined research sectors (for example, associations for chronic illness or entrepreneurial associations) are involved.

Social communication does not deal only with the reaching of a consensus on the contents of scientific activity, but it also has a great impact on the advancement of research, implying an exchange of knowledge between diverse social actors which allows a contextualisation of scientific knowledge (for example, about knowledge of markets, or on the use of productive factors and so on that a large company can bring).[29] In this sense, social communication precedes and facilitates the transfer of technology, since it intervenes before the research trajectory "solidifies" into specific technologies.

This component seems to be dominant in the work of such organisations as research parks and research consortia which co-involve universities and companies, or small to medium enterprise associations set up to work together in research programmes.

Political communication

Political communication is the component that deals with the relations between scientific communities and politics**,** meaning all the entities (political institutions, public administration, political organisations, political movements and so on) that have some say in public policy relative to science and technology.

The relevance of political communication is clear when we take into consideration the extent to which public policy, as well as having a bearing on the allocation of resources, is also a vehicle for interpretations of reality which influence the positions of different actors involved. In the case of scientific research and technology, for example, public policy not only contributes to the definition of research objectives and directs the utilisation of the results of scientific activities, but in the final instance, they are also bearers of theories with regards science, technology their function and use.

In this sense, exchange with the political community constitutes an important element in the whole creative process for the scientific community. This is because political leaderships, through their view of reality and their choices, define the working environment for researchers, transcending any single laboratory or company. These leaderships play a fundamental role in the emergence of new-found knowledge through their proposals, their dedication, their assumption of responsibility, their economic support.[30]

It is important to clarify that political communication is not only developed in parliamentary buildings or at ministerial level, where contact between the scientific community and the world of politics is episodic; nor is it only that implied in the technical workings of decision-making processes (evaluation committees, pools of experts and so on). It rather finds its greatest expression in those (rare) situations where attention is focused on general research strategies and where interaction becomes continuous and managed with greater awareness, such as in the preparation process of research programmes, or in some tables for territorial development; often managed through a mediatory figure (often scientists lending themselves to politics) who is able to translate political demands into scientific questions and vice versa.

Network communication

Another important component in science communication is network communication, referring here to the communication set up by social and functional research initiatives for the gathering of information concerning reality**.** However, developmental projects also have recourse to this type of communication as they increasingly assume an experimental nature or include analysis or interpretations of reality not only by researchers and experts but also, due to increased mobility, of the actors themselves.[31]

If this type of communication is included among the components of science communication it is because it tends to produce new knowledge about reality and often constructs and circulates representations of science and technology.

This happens in the main because many phenomena of a social nature can be known only when they are acted upon. In this sense, tools intended for the modification of reality, such as training, capacity building or the creation of businesses, also become tools for knowing reality, just in the same way that in order to know determined physical or chemical phenomena, work must be carried out on the material in question. Here, this can be described as action heuristics, that is, action which produces knowledge, something that works as a pivot in network communication.

We can add to this the fact that numerous social research projects and many development projects bring about the emergence and formalisation of tacit knowledge**,** held by specific social groups which are often decisive in the comprehension of important aspects of reality, such as the functioning of ecological systems, geological risks, the management of water resources, organisational dynamics or the dynamics of poverty and social exclusion.[32]

General communication

The final component of science communication is that which dominates relations between the scientific community and public opinion**.** The expression used here of general communication rather than the more common scientific popularisation is intended to underline the fact that this type of communication, as with those previously presented, is not one-way (from the science community to public opinion) rather it is interactive, implying an exchange of knowledge and ideas in both directions.

In fact, the information originating from the scientific community comes back not merely changed but also weighed down with new questions, information and interpretations.[33]

This does not mean a mere echo of the original message, nor does it imply a distortion or that it is in some way impoverished. On the contrary, feedback is the fruit of reflection on the message by strong cognitive operators at a societal level, who are able to collect diverse information, compare it, interpret it and produce original syntheses of it. All contemporary societies (including those in developing countries) have a growing number of people that are capable of managing knowledge in a sophisticated manner; they are also to be found in increasing numbers within weak social groups such as immigrants or the poor.

In this context, therefore, it would be a serious mistake to consider general communication as being an accessory and marginal to science communication, the realm of a few specialists. The directions taken by research are influenced by the degree of consensus that can be reached within society, no less than how far they are the choices of political leaderships.

Above all, it is necessary to leave behind the misunderstanding according to which public opinion is an entity atomised into millions of individuals, each one of them singularly exposed to the messages transmitted by the scientific community. On the contrary, public opinion constitutes a structured entity, where multiple social actors and collectives exist, each one of them with their own representations and points of view, capable of heavily influencing research and its impact.

Science communication and the evaluation of science

The different forms of science communication described above are the reflection of an elaboration that comes about as a result of some fundamental principles:

- scientific research (including that developed in the field of sociology)[34] has a social nature and it is therefore open to sociological analysis;
- communication (in all of its components) is an integral part of the scientific research process;
- as with every form of communication, science communication is two-way, it activates feed-back processes which are a component of research and have a bearing on the trajectories and outcomes of research itself (for example, network communication favours a widening of the empirical base; intra-epistemic communication allows the weighing up of scientific validity of hypotheses and results);
- as with every form of communication, in science communication linguistic and rhetorical aspects are of utmost importance and therefore are not considered as distorting factors but rather an indispensable means in order that research may simply become possible.

We can underline that through the key of communication, it is certainly possible to obtain valuable information about what happens before (funding, the wider directions of the politics of science etc.) or after (economic exploitation, management of political and social impact of scientific discovery) the research activity, but above all it is possible to gather information about what goes on in research's black box, intended as the physical, social, institutional and cognitive location where scientific discovery and technological invention is formed and takes place.

Moreover, this formulation sets the foundations for the creation of new analytical tools and new indicators to put alongside those already in existence, to evaluate the quality of research, to know the "internal mechanisms of the black box" (communication strategies and the level of control over the linguistic dimension of these, feedback management, use of resources and so on), to be able to measure their relevance for their potential applicative contexts and to identify the obstacles that are often in the way of their advancement.

Looking at the communicative aspects of scientific activity and, therefore, at the social dialogue which goes on around it constitutes a real opportunity, especially considering what is at stake, which consists in using effectively one of the most important resources that we collectively have at our disposal today, that is knowledge.

Notes and references

[1] On the theme of the impact of electronic communication on scientific production see P. Greco, "La scienza on line circola come ai tempi di Galileo Galilei", *Teléma*, 18, <http://geocities.com/CollegePark/Classroom/6218/giuristi/greco.htm>.

[2] On this subject we can cite "Il modello Venezia. La comunicazione nell'era post-accademica della scienza", in N. Pitrelli e Giancarlo Sturloni (a cura di), *La comunicazione della scienza. Atti del I e II Convegno nazionale*, ZadigRoma, Roma, 2004, p. 11-35.

[3] R. K. Merton, *La sociologia della scienza. Indagini teoriche ed empiriche*, Franco Angeli, Milano, 1981; Id., *Scienza, tecnologia e società nell'Inghilterra del XVII secolo*, Franco Angeli, Milano, 1975; R. K. Merton, (in collaborazione con J. Gaston), *La sociologia della scienza in Europa*, Franco Angeli, Milano, 1980.

[4] M. Bucchi, *Scienza e società. Introduzione alla sociologia della scienza*, Il Mulino, Bologna, 2002.
[5] R. Collins, *Conflict Sociology*, Academic Press, New York, 1975.
[6] L. Leydesdoff, H. Etzkowitz, "The Triple Helix as a Model for Innovation Studies", *Science and Public Policy*, 25, 1998.
[7] J. Wajcam, "Feminist Theories of Technology", in Jasanoff *et al.* (eds.), *Handbook of Science and Technology Studies*, Sage, London, 1995.
[8] K. Knorr Cetina, "Laboratory Studies. The Cultural Approach to the Study of Science", in Jasanoff *et al.*, cit.
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[11] B. Latour, *La scienza in azione. Introduzione alla sociologia della scienza*, Edizioni di Comunità, Torino, 1998.
[12] W. Bijker, *La bicicletta e altre innovazioni*, McGraw-Hill, Milano, 1998.
[13] M. Gibbons *et al.*, *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, Sage, London, 1994; H. Nowotny *et al.*, *Re-Thinking Science. Knowledge an the Public in the Age of Uncertainty*, Polity Press, Cambridge, 2001.
[14] The importance taken on by the communication of scientific production is given particular significance by Cannavò, in L. Cannavò (a cura di), *Le reti di Prometeo. Ambienti, culture e valori delle professioni scientifico-tecnologiche*, Franco Angeli, Milano, 1996.
[15] This request is well-formalised in P. Sztompka, "Shaping Sociological Imagination. The importance of theory", in Alexander J. *et al.*, *Self, Social Structure and Beliefs. Explorations in Sociology*, The University of California Press, 2004.The document is available at <http://www.sociolog.net/sztompka.html>.
[16] I. Lakatos, "La falsificazione e la metodologia dei programmi di ricerca scientifici", in I. Lakatos, A. Musgrave (a cura di), *Critica e crescita della conoscenza*, Feltrinelli, Milano, 1976.
[17] R. K. Merton, *Teoria e struttura sociale*, Il Mulino, Bologna, 2000.
[18] It is this, without any fear of being accused of eclecticism and given the acknowledged merits of "disciplined eclecticism" that allows the mixing, according to Sztompka e Alexander, of theoretical and disciplinary boundaries. In this regard, see P. Sztompka, cit.
[19] The following typology was proposed by G. Quaranta in some seminars held in June and July 2004 in the School of Sociology and Human Sciences promoted by CERFE.
[20] L. d'Andrea, G. Quaranta, "Soggetti e rischi sociali: contributo per una teoria generale", *Democrazia Diretta*, 3, 1995.
[21] The theme of building credibility for members of the scientific community has been dealt on a wide scale within the sociology of science; see, among others P. Bourdieu, cit. On the specific aspect of trust one can easily consult H. Longino, "The Social Dimensions of Scientific Knowledge", in Edward N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy*, Summer 2002 Edition, <http://plato.stanford.edu/archives/sum2002/entries/scientific-knowledge-social/>.
[22] P. Teilhard de Chardin, *Le phénomène humain*, Ed. du Seuil, Paris, 1955.
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[24] The mechanism of peer assessment, as Cerroni states, tends to be conservative; A. Cerroni, "Socio-Cognitive Perverse Effects in Peer Review. Reflections and Proposals", *JCOM*, 2(3), September 2003, <http://jcom.sissa.it/focus/foc020305.pdf>. On the same point, see the contrasting article by the sociologist Granovetter entitled "The Strength of Weak Ties", which has had great impact on economic sociology; cf. A. Barabàsi, *Linked. The New Science of Networks*, Perseus Publishing, Cambridge MA, 2002, p. 41-42; or the difficulty that Einstein had when trying to get accepted into university told by Bodanis, in D. Bodanis, $E=mc^2$. *A Biography of the World's Most Famous Equation*, MacMillan, Basingstoke and Oxford, 2000, p. 78.
[25] This point of view has also been expressed by M. Guggenheim during a presentation of his paper at the 4S & EASST Conference in Paris from 25-28 August 2004, in particular during the session dedicated to "Discipline and Research: Practices of Interdisciplinary Co-operation in Science". The paper (unpublished) presented was "Undisciplined Experts. Why the Loss of Discipline Leads to a Strengthening of Organizations".
[26] On this theme see P. Bourdieu, cit.
[27] I. B. Cohen, *Scienze della natura e scienze sociali. Prospettive critiche e storiche sulle loro interazioni*, Editori Laterza, Bari, 1993, p. 67.
[28] *Ibidem*, p. 76-77.
[29] Regarding this type of cooperation, we can mention that which took place between the inventor of the steam engine, Watt, and his colloborator Boulton. The latter, according to Baumol, had a point of view and knowledge of market economy that induced Watt to direct his efforts for the development of his engine which turned out to be a success; cf. W. J. Baumol, *The Free-Market Innovation Machine. Analyzing the Growth Miracle of Capitalism*, Princeton University Press, Princeton and Oxford, 2002, p. 36-37.
[30] This point of view is put forward by Nonaka e Konno. Although these authors make reference to multi-national compnies, this can also be transferred to political communication; see I. Nonaka, N. Konno, "The Concept of 'Ba': Building a Foundation for Knowledge Creation", *California Management Review*, 40, 3, Spring 1998, p. 53. The text is available at <http://www.business.utah.edu/~actme/7410/Nonaka%201998.pdf>.
[31] The list could be endless. We can mention the urban or rural development projects that take place within the context of international cooperation. There are some interesting examples in the collection of best practices published periodically by the United Nation's Habitat Agency.
[32] The most important international institutions for the promotion of development are well aware of this fact. The World Bank, for example, has promoted together with other organisms a programme called "Indigenous Knowledge Initiative", which aims, amongst others, to construct a data bank containing relevant indigenous information for the development of sectors such as the environment, nutritional health etc. (cf. <http://www.worldbank.org/afr/ik/datab.htm>). The CERFE, in 1986-1987, carried out

research *Study of Several Risk Factors in Italy. Landslides, hydro-geologic risks, earthquakes, risks associated with industrial facilities*, based on the utilisation of popular knowledge for the localisation or environmental risk factors. Similarly, in 1996-1997, the CERFE held the *Course on the Collection and Utilisation of Social Information in Managing Environmental Risks in Bulgaria*.

[33] N. Pitrelli, "The Crisis of the 'Public Understanding of Science' in Great Britain", *JCOM*, 2(1), March 2003, <http://jcom.sissa.it/focus/foc020101.pdf>.

[34] The application of analysis criteria for the sociology of science to sociology itself is a principle affirmed in D. Bloor, cit.

Authors

Luciano d'Andrea is a sociologist, researcher at CERFE, and has been engaged since long time on research activities in the fields of science and technology. He is the author of *Manuale sui processi di socializzazione della ricerca scientifica e tecnologica*, CERFE, Roma, 2005, and *Il ritorno della città. La base umana della globalizzazione*. Officina Edizioni, Roma, 2000, both co-authored along with G. Quaranta and G. Quinti. E-mail: luciano.dandrea@cerfe.org

Andrea Declich is a socio-economist, researcher at CERFE. He has carried out research activities, both theoretical and empirical, on topics connected to the scientific and technological development and to science communication. In particular, a special mention goes to the researches on small enterprises, on entrepreneurship, on the diffusion of telemedicine, on water offer and the sanitation in underdeveloped nations, on the social capital and the civil society, and on the urban development and the methodology of the social search. E-mail: andrea.declich@cerfe.org