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The role of networks of practice, value sharing, and operational proximity in knowledge flows between professional groups

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ABSTRACT

This article investigates the process of knowledge sharing between individuals in different professional groups. Through an ethnographic study in a hospital unit, we examine the individuals' involvement in networks of practice, their sharing of organizational values, and their operational proximity. Recent attention to networks of practice has led to a view of organizations as crossroads of networks; accordingly, boundary relations between different networks of practice are of core relevance to ensure knowledge diffusion in organizations, but empirical evidence is still lacking. Our grounded theory supports the idea that working side-by-side and having common organizational values are important bases for knowledge transfer between professional groups which belong to different networks of practice. Boundary knowledge transfer evokes new kinds of organizational citizenship behaviours. Professionals who initiate the transfer exhibit extra-role behaviours which, in turn, require the recipient to perform extra-role behaviours as well. Implications of knowledge sharing between professional groups are discussed together with recommendations for managerial action.

KEYWORDS

ethnography ▪ healthcare ▪ knowledge ▪ networks of practice ▪ Organizational Citizenship Behaviours ▪ professional groups

Introduction

Over the last 10 years in the academic and managerial literature there has been a growing interest in communities of practice as a means for transferring and generating knowledge within organizations. Communities of practice are self-managing systems whose members spontaneously share working practices, are aware they belong to a group that possesses unique and lasting values, and develop a common repertoire of routines, expressions, and actions. The same distinctive features apply to networks of practice; that is, spontaneous groupings of peers with similar skills and positions, albeit mostly in different organizations and therefore with weaker links than those pertaining to communities. One particularly important topic which has as yet to have been explored empirically is knowledge flow between the heterogeneous communities and networks that cut across an organization. The common assumption is that the more intense the participation in a community, the more conflicted the sharing of practices between different communities will be.

Our research aims to formulate a grounded theory that is concerned with the factors that promote exchanges of knowledge between groups of professionals belonging to different networks of practice. We derive this theory from an ethnographic study carried out in the radiation oncology unit of a major hospital in northern Italy.

Knowledge and networks of practice

Cognitive and socially situated learning theories

In the debate about knowledge regarding organization studies over the past few decades, the more established cognitive theories of knowledge represent different assumptions than those of the more recently adopted socially situated theory.

In cognitive theories, knowledge is seen as a collection of entities (or 'bodies of knowledge') contained in the mind of the learner. Here, learning is the process of individually acquiring these entities through a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984).

Conversely, at the core of socially situated learning theory is practice: how actors act and interact in order to perform their daily activities in a social setting. Practices are the means through which knowledge dynamics unfold, and therefore practice is the unit of analysis for understanding knowledge processes in organizations.

These two views of learning (that is, cognitive theory and socially situated learning theory) have different ontological premises and different implications on the management of knowledge processes in organizations (Lave, 1996; Easterby-Smith et al., 1998; Gherardi, 2001). According to cognitive theories, knowledge is a reified entity which resides in the minds of individuals (Argyris & Schon, 1978; Nelson & Winter, 1982). Organizations learn by turning individual knowledge into organizational assets (Nicolini & Meznar, 1995; Easterby-Smith et al., 1998). One way this can be done is through the storage of individual knowledge in organizational structure and routines (e.g. Argote, 1999).

In a socially situated view of learning, individuals continuously combine and modify knowledge through their everyday operations and interactions (Lave, 1996; Wenger, 2000). Thus, context-specific, non-individual knowledge that resides in social relations is relevant and worthy of investigation (Brown & Duguid, 1991; Turnbull, 1993; Hard, 1994; Araujo, 1998). Here, learning is a matter of interpretation; knowledge cannot be separated into individual minds, but develops only within a domain of collective knowing and doing (also known as a practice). Organizational research, then, must address the process of knowledge generation and flow in specific social settings (Gherardi, 2001) as well as consider the question of how to transform operational knowledge into abstract knowledge (i.e. concepts) (Nicolini & Meznar, 1995). Nicolini and Meznar (1995) suggest that an observer enters a social setting after a change in the setting or situation has occurred; the observer then tries to gain control over the reflection process that the actors put into place.

Another difference between these perspectives refers to the locus and nature of new knowledge. In the cognitivist stance, new knowledge emerges from meaningful advancements, like scientific discoveries and innovations made in identifiable places, such as public or private institutions or firms. On the other hand, in the socially situated view, new knowledge stems from dilemmas and contradictions among actors that hamper ongoing activity (Blackler, 1995; Lave, 1996; Gherardi & Nicolini, 2000; Wenger, 2000; Bechky, 2003).

Communities and networks of practice

Lave and Wenger (1991) proposed to study communities of practice in order to better understand knowledge in organizations from a socially situated standpoint. Later, Wenger (1998) identified three distinctive features of communities of practice: 1) the reciprocity of relations between members (mutuality); 2) the sharing of a common sense of belonging (joint enterprise);

and 3) the production of a common repertoire of languages, routines, artifacts, instruments, and styles (shared repertoires). One central aspect of communities of practice is that, through working side-by-side, their members convey knowledge both explicitly (that is, the knowledge that can be recounted) and tacitly (knowledge that cannot be expressed nor articulated in formulae, reports, or drawings) (Brown & Duguid, 1991).

Some examples of communities of practice in work settings include nurses on a hospital ward (Wenger, 1996), a group of technicians in charge of repairing Xerox photocopiers (Orr, 1996), and Navy quartermasters tasked with coordinating navigational procedures (Hutchins, 1996).

Within the boundaries of an organization, a number of different communities co-exist; members of a single community also belong to a broader community that cuts across different organizations. It is appropriate to think of these communities, which are themselves composed of several smaller local communities, as 'networks of practice' or 'networks of knowing' (Brown & Duguid, 2001). The substitution of the term 'network' for the term 'community' implies that relationships within a network are weaker than those among the members of a community. Indeed, although they share practices and hence knowledge through venues such as conferences, journals, mailing lists, online communities, and so on, network members often have few opportunities to get to know one another on a personal basis, or even to meet face-to-face. This stands in contrast to the familiarity and habit of occupying the same physical space within communities.

Wenger (2000: 227) provides an effective description of the potential for influence on a community via networks of practice:

> We have been with a community for a long time [. . .] But something happens. We are sent overseas. We go to a conference. We visit another department. We meet a 'stranger' with a completely different perspective. Or we just take a long walk or engage in a deep conversation with a friend. Whatever the case may be, we have an experience that opens our eyes to a new way of looking at the world. This experience does not fully fit in the current practice of our home communities [. . .] We come back to our peers, try to communicate our experience, attempt to explain what we have discovered, so they too can expand their horizon. In the process we are trying to change how our community defines competence.

Every community or network develops and reinforces its own domain of knowledge through the actions and conversations that unfold within it (a process known as 'perspective making'); at the same time, individuals

belonging to different communities or networks that cooperate with one another transfer knowledge through a process of reciprocal exchange termed 'perspective taking' (Boland & Tenkasi, 1995). For perspective taking to occur, 'complexification' within a community must develop; in other words, a community's uniqueness and differentiation of knowledge has to be strengthened before searching for integration with other communities.

The boundaries between communities of practice represent, on the one hand, a barrier between different sets of practice and, on the other, an opportunity for cross-fertilization and for the discovery of different perspectives (Engestrom & Middleton, 1996). However, barriers are expected to prevail; since the specificity of the practices of a given community helps to create a strong collective identity among its members, these specialized practices actually raise barriers between different communities. The possibility of sharing knowledge at the boundaries of different communities depends in part on the ability of a member, when faced with the need to cooperate, to temporarily suspend her community identity in order to capture the languages and actions proper to the members of other communities (Schein, 1995). Though necessary, complexification likely leads to incommensurability between communities' views (Knorr-Cetina, 1981; Czarniawska-Joerges, 1992; Boland & Tenkasi, 1995). Being able to understand how the knowledge from a different community fits within the context of one's own work requires a process of transformation – not merely of transfer – between communities (Bechky, 2003), or the formation of a common discursive community above and beyond a single community (Gherardi & Nicolini, 2000).

Our article intends to further address and elucidate boundary relations. From a theoretical viewpoint, the relevant literature has concentrated thus far on the creation and transmission of knowledge within individual communities of practice and on the divergences between different communities (Fitzgerald et al., 2002; Bechky, 2003). Conflicts that act as occasions for changing practices in social settings according to socially situated learning appear to be especially frequent and intense at the boundaries between professional groups (Gherardi & Nicolini, 2000; Wenger, 2000; Bechky, 2003).

The intensity of involvement in a single network, in turn, reinforces a sense of belonging, relational mutuality, and common repertoire among its members. When this occurs, knowledge flows with other networks become increasingly difficult. In particular, different technical languages hinder understanding and sharing of practices between professional groups (Gherardi & Nicolini, 2000; Bechky, 2003).

Building on the understanding that knowledge is socially situated, we

examine the processes whereby heterogeneous professional groups share practices and therefore knowledge. Our aim is to construct a grounded theory that relates these processes to the individual's level of participation in networks of practice. Besides reinforcing a single community's identity, networks of practice provide their members with the opportunity to confront, modify, and combine their practices, resulting in new knowledge available to their own communities and organizations. We intend to grasp under what circumstances the new knowledge available through networks of practice spreads to members of different professional groups, thus overcoming the traditional obstacles to inter-group knowledge sharing that have previously been examined in the literature.

Data and methods

The research type and context

Different epistemologies stem from different ontological assumptions of knowledge as either individual cognition or as socially situated (Blackler, 1995; Easterby-Smith et al., 1998; Bechky, 2003). Qualitative research enables the researcher to capture the context-specific aspect of knowledge and is consistent with an understanding of knowledge as a social construction (Miner & Mezias, 1996). Of the various types of qualitative research, ethnography is by its nature well suited to grasp the social dimension of knowledge by instantly observing phenomena at the time and at the place where they occur (Macrì & Tagliaventi, 2000).

A qualitative ethnographic approach was therefore appropriate for our research goals. We conducted a field study in the radiation oncology unit of a major hospital in northern Italy. We chose this setting for two reasons. First, the radiation oncology unit brings together four different professional groups: doctors, radiotherapy technicians, medical physicists, and nurses. Healthcare settings are professionalized institutions in which different groups with specific rules, job representations, behaviours, and values converge (Schein, 1996; Drucker, 2002). On the wave of the New Public Management theory, the introduction of a managerial perspective in hospitals and the redefinition of organizational structures around treatment processes bring new attention to the interactions between groups (Ferlie et al., 1996; McNulty, 2002). Studies have underlined the different identities (Engestrom, 1996), the conflicting relationships (Chambliss, 1996), and the development of complex power relations between professional groups (Doolin, 2003). The few studies investigating knowledge exchanges between professional groups in hospital settings do not focus on daily activities, but on temporary relations linked to ad hoc projects (Fitzgerald et al., 2002; Newell et al., 2003).

Second, radiation oncology practices in general, and practices on this unit in particular, are high-tech. The unit is renowned both in Italy and internationally for the cutting-edge content of its machinery and treatment techniques; its staff must constantly keep abreast of ground-breaking research and technology. The need for continual training intensifies the need for participation in courses, conferences, staff swaps with a variety of different units and hospitals, informal meetings, etc.

In order to gain a better perspective of the daily practices of this particular unit, we first mapped the radiotherapic process through interviews with the head of the unit, the chief nurse, the technical director, and the head of medical physics as well as through examinations of official documents (job descriptions, organizational charts, internal papers, and consultants' reports). The radiotherapic treatments, which consist of high- or medium-energy irradiation of tumours using special equipment called accelerators, are mainly provided via the application of official protocols.

Figure 1 shows the process and the rooms where treatments take place as well as the actors involved at each stage and their interdependencies. The patient makes an appointment for an initial examination through the nursing staff. The examinations are held in a room on the unit two mornings per week and may require an external specialist (an ear-nose-and-throat specialist or a gynaecologist), in which case the unit doctor and the external specialist jointly make the treatment decision. Based on the information provided by the doctor, a technician creates an immobilization device which is then used to ensure the centring of the patient on the accelerators. The patient undergoes

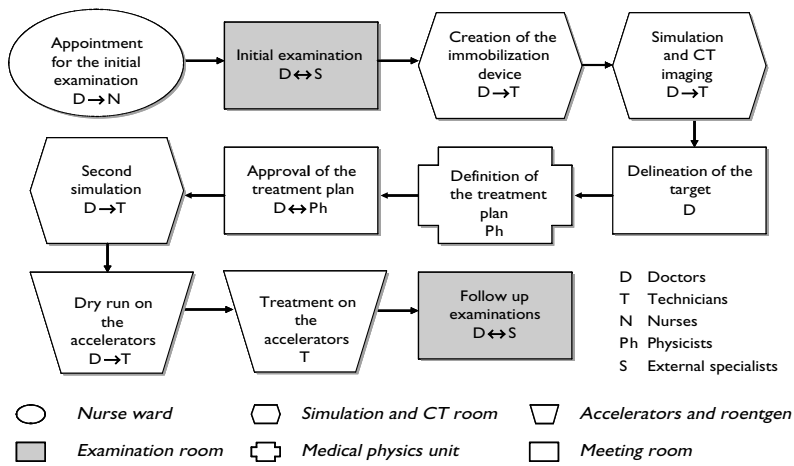

Figure 1 Rooms, actors, stages, and interdependencies in the unit's work process (→ = sequential interdependence, ↔ = reciprocal interdependence)

a 'simulation' of the treatment and a technician acquires CT images under a doctor's supervision. The technician sends the images electronically to a doctor who, using specific software, draws the 'target' (that is, the area of the patient's body that is to be irradiated). Using the target that the doctor has sent electronically to the medical physics unit, the physicist defines the treatment plan (i.e. the dose of energy and the accelerator programming). The doctor who has outlined the target, in consultation with the physicist who has drawn up the treatment plan and who in this instance may go to the radiation oncology unit's meeting room, jointly approve the final version of the treatment. In the 'second simulation', the doctor provides the technician with the final parameters of the patient's treatment and the technician checks that the patient is correctly positioned on the machine. After a dry run on the accelerators, the patient begins her radiotherapic sessions; these are administered by two technicians under the supervision of a doctor. The nurses' role is to manage the appointments diary, take charge of patient admissions, and support the work of the doctors and technicians in the various rooms.

Although the members of professional groups are able to perform all the activities required, their individual participation in the different phases may change. Rotations regulate the workers' presence in rooms where radiation exposure is higher (for the same reason, pregnant employees are not allowed to work in the accelerator rooms). There are a few staff members who carry out mostly back office activities, such as a doctor (D5[1]) who writes treatment plans or a technician (T1) who mainly makes immobilization devices.

Of the stages described, given the formal design of the process, it is only the initial examination and the approval of the treatment plan that entail reciprocal interdependencies (Thompson, 1967). In these cases, interdependencies link the unit doctor and the external specialist, in the first case, and the unit doctor and the physicist in the second. The different professionals in the other stages are expected to interact according to sequentially interdependent patterns, in which the member of a professional group transmits information (parameters, appointments, type of immobilization device, etc.) to a co-worker of a different group.

Moreover, an advanced intranet links doctors and technicians to the medical physics unit (which is de-localized) through the pooling of imaging, CT scans, treatment plans, and patient case data.

Finally, the unit has a quality manual that prescribes roles and responsibilities of all the members of the unit. Especially critical are those treatment phases where the professionals work 'on' the patient. In these phases, the professional in charge needs to sign every single document.

The 35 actors who work in the radiotherapy unit are as follows: nine doctors (including three trainees), six physicists (including two trainees),

13 technicians and seven nurses. Fifteen of the 35 staff members are men and 20 are women. Excepting the trainees, the average age at the beginning of this research was 40.8 years with a standard deviation of 4.6 years. On average, staff members' unit tenure was 8.4 years (SD = 2.3 years), while the average overall working experience was 16 years (SD = 3).

Data-gathering and analytic techniques

Following the initial interviews and examination of documents, we made use of participant observations and semi-structured interviews to perform an in-depth study. The participant observations unfolded in the rooms of the radiation oncology unit (see Figure 1) between July and December 2002.

Given that operators work mainly from 8am until 2pm and only one of the three treatment machines runs during the afternoons, we conducted our observations mainly in the mornings for 21 weeks, five days a week, and 18 hours per week on average. We observed each of the rooms three hours per week on average, for a total of 364 hours. Observations were distributed uniformly throughout the working day, in the various rooms, and on the various days of the week so as to best sample the activities performed in the unit.

During the observations, we took notes on paper describing everything that happened, including individuals' actions and interactions, while respecting the actors' original language (Glaser, 1978). At the end of each day these notes were transcribed into files. When we completed our observations, we codified the field notes taking the interaction as the unit of analysis. We first created a database in which we entered and codified all the interactions observed (11,396) in accordance with multiple categories (the actor prompting the interaction; the actor or actors involved in the interaction; the driver; the subject; the modality of communication; the presence of open conflict). We next identified those interactions that showed an explicit knowledge content. In line with a view of knowledge as socially situated and residing in practices, we coded those interactions that described how to do things as knowledge-related; these interactions were potentially able to affect practices. For example, the communication of a patient's details or clinical history, the location of a clinical file, or the confirmation of an appointment were not considered to entail any transfer of knowledge unless the actor supplying the information in question explained or demonstrated to the recipients how to obtain or locate such information.

Every record relating to an interaction that featured knowledge content contained not only basic ID data (date, room, and text), but also the following details:

- the identity of the person supplying knowledge;
- the person or persons receiving this knowledge;
- an assessment of whether or not the interaction in question belongs to a 'cluster'. A cluster consists of interactions (which may occur at different times and places) that are linked to a single subject. For example, a series of interactions among various actors for passing on a procedure for centring patients suffering from a particular pathology would be considered a cluster. A cluster of interactions shows a pathway of practice diffusion within the unit.

We separately selected knowledge-related interactions first, then met to discuss our choices. Those interactions about which no agreement could be reached were discarded. We subsequently separately re-coded the 741 interactions that we both agreed had knowledge content with reference to the other criteria. The inter-rater reliability on the coding criteria was approximately 70 percent; through discussion, we determined the coding criteria of those interactions that had not initially been agreed upon.

From the database containing the knowledge-related interactions, we derived an asymmetrical 35 × 35 actor-by-actor matrix, and we made use of the Net Draw application provided by UciNet to graphically display the relations between actors (Borgatti et al., 2002). Net Draw represents actors and knowledge-related interactions using nodes and arcs, respectively; two individuals with a greater number of interactions would have nodes closer together than those with fewer interactions. From our overall observations, we then calculated the number of hours that the actors worked together in the same room; this calculation was represented by a symmetrical 35 × 35 proximity matrix. More specifically, we measured proximity as the time that individuals spent sharing objects, spaces, and activities as a consequence of the requirements of the treatment process depicted above (Kiesler & Cummings, 2002), and not as the physical distance between them (Allen, 1977). We then used the Quadratic Assignment Procedure to determine whether there was a correlation between the proximity matrix and the knowledge-related matrix[2] (Hubert & Shultz, 1976; Krackhardt, 1987).

We identified the actors' memberships in networks of practice and obtained information relating to the intensity of their contacts through semi-structured interviews with each of the 35 actors attached to the unit. These interviews lasted approximately 30 minutes. Each interviewee reported how much time (on average during each year they had been working at the unit) he or she had devoted to: external training; participation in conferences, workshops, or professional meetings; mailing lists; teaching sessions; self-training; consultations with specialists external to the unit; and/or intra-group

meetings. We invited the interviewees to comment freely on each of the participation modalities, highlighting their limitations, drawbacks, or strengths.

Along with these interviews, we also consulted staff training programmes, quality manuals, budgets, and trade union reports to reach a better understanding of the formally prescribed training demands placed on the various professionals.

Evidence gathered in the field

Inter-group knowledge exchanges

> T5 asks D8: 'How do we make this mask?', while delivering the patient's documents to him.
>
> D8: 'Go for the extended version, since it's the best way to preserve the body part from radiation damages'.
>
> T5: 'OK. So, when it's about the oesophagus, I have to take a long mask, in place of a short one, right?'
>
> D8: 'Yeah. Now that you've got it, you can do it on your way, even with no doctor around'.
>
> T5: 'Kind of'.

The excerpt from the field notes quoted above is an example of inter-group interaction featuring knowledge content. Without following any formal requirement (in this phase, doctors need to provide technicians with parameters only), a doctor explains to a technician how to select the type of mask he has to make. As the doctor clearly states, he assumes that, from that moment on, the technician will be able to choose on his own what mask to make, even though this is the doctor's task. Knowledge-related exchanges of this kind require the active actor to transfer a practice of her own professional group to the member of a different one, while at the same time implying that the recipient is willing to perform it autonomously later; such exchanges account for 62 percent of all knowledge interactions. When faced with momentary shortages of resources, inter-group practice sharing allows professionals to gain margins of operational autonomy. In the excerpt below, a physicist teaches a doctor how to print out and check a treatment plan so as not to stop the work process if a physicist is not available:

> Ph2 opens the file and tells D8: 'All you have to do is press "print all the rows" button'.

D8: 'Of the series?'

Ph2: 'Right. Then manually check . . .'

D8: 'What should I check? Just if any row appears?' Ph2 shows him how to do the manual check on video.

Ph2: 'Yeah. Now, D1 is waiting for me in the meeting room. Do you feel like doing it yourself?'

D8: 'Sure. We can't keep Mark [a patient] waiting, he is really sick today'.

Different professional groups' practices subsequently spread within one's own group. In the following excerpt, doctor D2 shows doctors D1 and D4 how to perform a typical technician's task in the simulation room (acquiring the images and running the machine safely). During the process, the machine breaks and D2 teaches D1 and D4 a switching-on trick he has learnt from technician T5 that enables them to go on with the treatment. T5, in turn, had learnt the practice from the external technician in charge of the periodical maintenance of the simulation machine.

D2, D1, D4 and a patient are in the simulation room. The technician is momentarily away, but the doctors decide to proceed anyway with positioning and image capture.

D2 says: 'Now let's have a look at the image, because we have to get it well centred.'

D2 says to D4: 'You have to press that. Now, the image is coming up. We need to reposition him [the patient] a bit better. Without a technician around, it sure is tricky'.

D2, D1 and D4 go into the simulation room and together reposition the patient. The machine gets stuck.

D1 turns on the lights and says, 'Now what?'

D2: 'We just have to turn the whole thing off and then back on again. It usually works when T5 does that. He actually told me that he learnt it from the repair technician coming over here'.

T9 arrives and says in astonishment to D2: 'Fine, fine. I see you can manage the whole thing without me.'

D1 replies, smiling: 'So we don't have to tell the patient: just sit there, God knows for how long, and wait for our colleague to be back.'

Another set of inter-group interactions displaying knowledge content refer to practices that help the recipients to better accomplish their own duty. In this case, the active actor shares her own professional group's practices with members of different groups to improve the latter's performance. In the following excerpt, a physicist explains to a technician how to effectively position a patient on the machine:

> Ph5: 'Is it you [technicians] who put those little things down there?' He is pointing at a few small plastic pyramids on the immobilization device.
>
> T1: 'I don't frankly know.'
>
> Ph5: 'The TEMA [the company in charge of the machine maintenance] operator rightfully told me that, if we do so, the patient doesn't lie flat anymore and he's not stuck to the machine. That could be pretty risky.'
>
> T1: 'Actually, they [the patients] always tremble a bit, but I ignored that it might be dangerous.'
>
> Ph5: 'Come here, I'll show you how to properly fix it.'

The sharing of practices simplifies communication between groups by promoting a common understanding of activities without the need to make them verbally explicit, and also by adopting a non-specialized language made up of generic nouns, pronouns, and adverbs ('stuff', 'it', 'there') that allows for crystal-clear reference to actions and objects.

Moreover, 74 percent of these knowledge interactions were mediated by the tangible presence of patients (35%), documents (22%) and machines (17%). As for the areas of the unit, 53 percent of knowledge-content interactions occurred in the rooms with machinery, 31.5 percent in the examination room, 4.8 percent in the meeting room, and 9.6 percent in the nurse ward.

The professional groups' common values

Practice sharing between members of different professional groups appears to be rooted in the common vision of the organizational unit shared by the unit staff. Despite the differences among the doctors, technicians, physicists, and nurses, during observations and interviews, several core values emerged that were deeply held by all the staff.

One strong value is the centrality of the patient. D6, the head of the unit, reminds another doctor that 'we accept everyone, regardless of their

income. We work on Saturdays, too, if necessary, though the trade unions complain. You can't do any different if you really want to help sick people.' Placing importance on the patients' needs is a value that is displayed in several ways: by providing them with a clean and cheerful environment (a local artist painted the machine rooms' ceilings and walls that now look like an aquarium); taking care of their psychological state (T4 recalls how colleagues in the unit where she previously worked used to look down on her whenever she spent some time talking to patients, but she notes that, 'Here things are different, fortunately. That's why I left'); and being willing to take on extra work whenever needed (N4 tells a co-worker: 'You can't stick to your job description if you choose to work in a place like this').

One statement by the head of the unit, D6, during the course of the interviews underlines the need to overcome strict specialization limits in order to better serve patients: 'Doctors are a bit like physicists, and the reverse is true.' Still, Ph4 noted how, during the elaboration of the treatment plan, he usually draws the line around critical limbs, though this is the doctor's responsibility. Otherwise, he has to identify the doctor in charge of the patient, contact her, and ask for explanations, 'which would take a lot of time, while someone is suffering out of the door'.

Another value connected with the centrality of the patient is the need for cooperation and the equal contribution of all the professionals to achieve the unit's goals. The head of the unit strongly affirms such equality to D8 when the latter asks for a permit to apply special treatment to a patient without consulting his colleagues: 'We are all here, not just you. We are all the same, never forget'.

Reaching consensus about the unit's values has sometimes been a stormy process. During a meeting in which the staff attempted to articulate the unit mission, individuals confronted themselves in a sharp, often tense way, as the following excerpt shows:

> D6 says: 'Our mission is to treat people who contact us in the best way ever possible, which means with the best technique available and in a time consistent with their illness.'
>
> N2 stands up: 'But this means everything and nothing at the same time!'
>
> D2 joins her: 'And where does learning exactly stay in such statement?'
>
> D8 breaks in in support of D6: 'It's inside it. When you stress the best technique available, you imply that you must be ready to study what the best technique is. Instead, I would clearly write down that we treat any patient, regardless of their probabilities of survival.'

> D2 raises her voice: 'That's unfair to me. We have to learn to say no to some patients'. Ph2 nods.

Fights occasionally occur in everyday activities if the patient's centrality is at risk. The head of technicians, T12, scolds a co-worker who tells him that the machine will not work on a certain afternoon due to the absence of the technician in charge: 'The machines have been working for 27 years, even before you and I entered this unit. If someone is missing, we sure don't close down.'

Conflicts in the unit do not arise only when common values and objectives are at stake. The differences between the professional groups and the tightness of the work flow, typical of healthcare settings, provide opportunities for arguing with and complaining about colleagues. It is interesting to notice that open conflicts – that happen when two individuals engage in an interaction characterized by animosity and hostility – pertain to less than 1 percent of the knowledge exchanges that we observed. In the following excerpt we show an interaction between doctor D6, who has just come back to work after two weeks of vacation, who complains about the absence of a piece of equipment for ear-nose-and-throat visits, and nurse N7, who in her turn reacts in an emotional way.

> D6 is clearly upset and raises his voice with N7: 'This piece of equipment should be here [in the visiting room]! This space is meant for ENT [ear-nose-and-throat] visits! I cannot always wait for you to set me up!'
>
> N7, raising her voice, too, replies: 'Unfortunately we don't perform only ENT visits here! We need to keep also obstetric equipment, which takes much more room! You should know that. Anyway, welcome back from vacation'. N7 leaves the room

The network of knowledge-related interactions and the effect of operational proximity

Figure 2 shows the graph of knowledge-related interactions among all the actors belonging to the unit. First of all, actors belonging to the same professional group are positioned in the same area of the graph, indicating that knowledge sharing within groups is intense. The graph further shows that certain actors (D8, D6, T5, T12, N7) act as brokers between groups.

D8 in particular acts as a broker between doctors, physicists, and technicians. D8 has a significant volume of interactions with T5, who in turn is linked to the technicians' group. D6 is central to her own group and is a

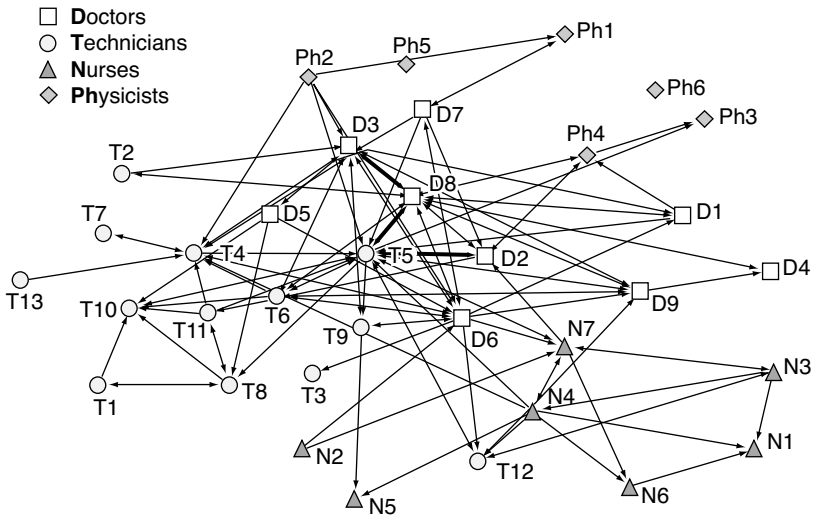

Figure 2 Graph of knowledge-related interactions

broker with other groups. The nurses appear to be more isolated and are connected to the doctors and technicians through N7 and T12, respectively. This is consistent with the specific responsibilities of the two actors: N7 is a nurse who deals almost exclusively with medications and patient transport; T12 schedules examinations and treatment sessions together with doctors and nurses. It is worthwhile to note that bi-directional knowledge exchanges occur between professionals, such as some doctors and technicians, for whom transfers of information only from one part to the other are designed.

We then attempted to grasp whether the intensity of operational proximity can explain the various roles in knowledge flows. QAP analysis showed a significantly positive correlation between the symmetrized knowledge-related matrix and the matrix of operational proximity (r = 0.725***, including the inter-group interactions only). In the context under study, the opportunity to work side-by-side positively affected knowledge flows.

The following example clarifies the importance of meeting face-to-face and sharing objects for members of different groups. During the observation period, a new software package was introduced in order to link the radiotherapy unit to the medical physics unit. This new tool aimed to share data about patients without the need for the physicists to visit the unit and discuss treatment plans with doctors. The tool was informally (and ironically) called 'Bilbo', to convey the idea that its goal was to connect two different 'worlds' (those of the doctors and physicists), like Tolkien's hero in *The lord of the*

rings. Eventually, after a few weeks the software was dismissed, since, in D8's words, 'it was not able to transfer and combine all the knowledge that is necessary to create an effective treatment plan, especially in non-routine cases, and it takes too much time and effort for a doctor to write the information in the electronic form'.

Participation in networks of practice and effects on knowledge-related interactions

Participation in networks of practice plays a key role in the staff's continuous training and updating to keep abreast of innovation. Nurse N7 thus expresses her engagement with ongoing training:

> Every day I happen to run into some new issue in medicine. I have a circle of friends with whom I share my interests and with whom I act as a point of reference. When I'm at home, I read books and journals [about my profession], and I love surfing the net, especially the Board of Nurses' website. I know I'm not the only one doing so in my unit.

The Italian health system prescribes a minimum number of yearly training credits (ECM, Continuous Education in Medicine) compulsory for all the hospital staff. The number of credits varies for the professional groups; for example, doctors and physicists are expected to attend more conferences and training programmes and to undergo more self-training than technicians and nurses. Once the official requirements of training are fulfilled, individuals can increase their participation in their own network of practice according to their personal willingness and to the unit's available financial resources.

Figure 3 reports the standardized intensity[3] of participation of the unit staff members to their respective networks of practice.[4] Of those actors who act as brokers between groups, D8, D6, T12 and N7 have many contacts with their respective networks of practice. T5, on the other hand, is average for his own group and scores below two actors (T3 and T4), neither of whom is a broker. For D7 and N2, although both have many contacts with their respective networks of practice, neither is central to her own group nor broker with other groups; this is explained by their lack of operational proximity with other actors. T12 represents a broker between groups, but is not central in her own group since she does not work alongside other technicians. The peripheral actors (N5, N6, Ph1, Ph5, T7, T13, and D5) all have a low level of relations with their networks and none of them works frequently in the rooms where several actors operate. Certain actors (D2, T8, and T9),

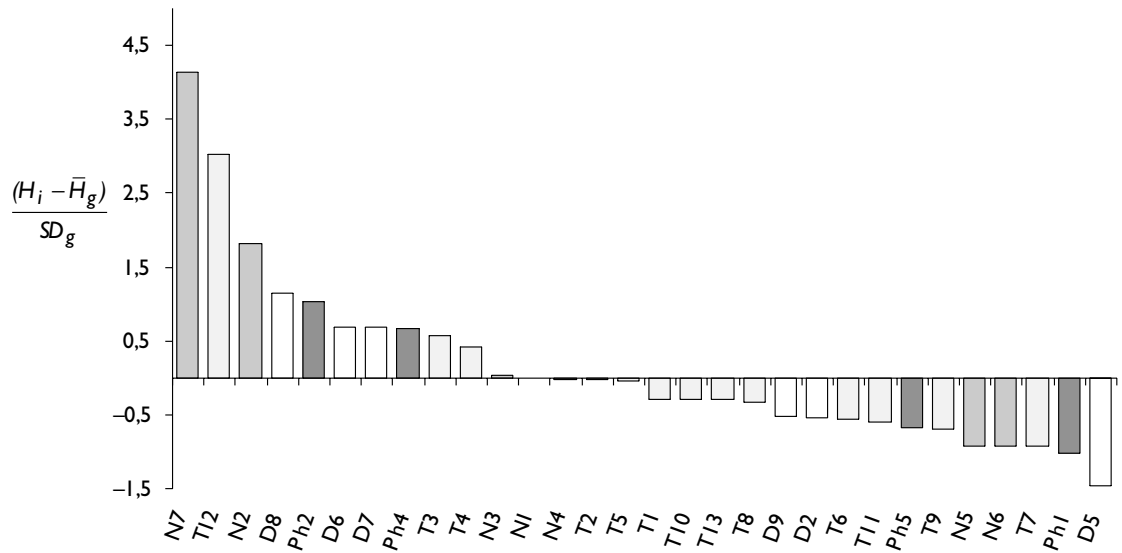

Figure 3 Histogram in which the intensity of actors' relations with their networks of practice (measured in terms of annual hours of commitment, H_i) has been standardized on the basis of the average ($\bar{H}_g$) and the standard deviation (SD_g) of each group

although they do not have many relations with their network of practice, are nonetheless involved in many knowledge exchanges because they share spaces and activities with other staff members.

Actors who act as brokers share spaces and activities with other actors, whereas their involvement in networks of practice varies. In this social setting, therefore, the volume of relations with networks of practice does not explain particular roles within the network of knowledge-related exchanges. An analysis of the clusters of interactions that we identified through our coding, on the other hand, enables us to distinguish roles in terms of varying intensities of participation in the networks of practice. Clusters highlight pathways of practice transfer over time. Of the 16 knowledge clusters identified, 14 were initiated by actors with high levels of relations with their networks (D6, D8, Ph2, D7, T12) and were related to the sharing of practices learnt in networks; one was initiated by an ear-nose-and-throat specialist and one by T5. The diffusion of practices through clusters modifies procedures and tried-and-tested techniques and/or introduces new ones. The following field note reports one significant instance of diffusion of practice. It concerns a new procedure for positioning patients suffering from breast cancer on the accelerator, which doctor D8 learnt while attending a conference and then spread throughout the unit (as represented in Figure 4). The pathway starts with a consultation between D8 and the physicist Ph2; next, D8 worked jointly with the technician T5. Ph2 and T5 in turn passed on the procedure to other physicists and other doctors, respectively.

> Returning from the simulation room, Ph2 shows Ph1 and Ph5 two screen images: 'Excuse me, guys, have you got a minute? Now, what I want to show you is this: the issue of the arm up or the arm down. Notice the colours.'
>
> Ph1: 'Increase the contrast a bit.'
>
> Ph2, pointing at the screen: 'D8 has explained to me that he prefers that one because the centring is clearer. He saw it done at a presentation at the last conference he was at and he says that at the end they talked it through for an hour and they all agreed it was preferable.'
>
> Ph5: 'Now that I think about it, it makes sense. It's a problem I had, too.'

One final remark about the clusters: the pathways of practice diffusion that are not initiated by those actors who are regularly most involved in networks of practice, that is, T5 and the external specialist, also result from opportunities gained through contacts with peers in other organizations.

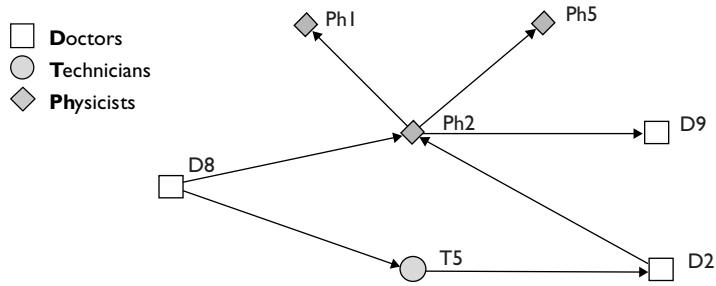

Figure 4 Pathway of diffusion of an innovative practice for positioning patients affected by breast cancer on the accelerators; the lines show the knowledge-related interactions that we observed related to that practice

The grounded theory

An emerging view in the literature sees organizations as crossroads of networks of practice. Networks of practice are sets of individuals who share common values and ways of doing things, that is, practices. In the socially situated perspective that inspires the definition of networks of practice, individuals continuously combine and modify knowledge through their interactions, and knowledge as practice is the focus of investigation (Lave & Wenger, 1991). Boundary relations between networks of practice are critical, particularly the pathways for knowledge sharing among professional groups within an organization. Though empirical evidence is still largely lacking, theoretical assumptions suggest that an individual's intensity of involvement in networks of practice reinforces his or her network-specific knowledge, while at the same time making knowledge flows among different networks problematic, if not conflicting (Boland & Tenkasi, 1995; Orr, 1996; Wenger, 2000; Bechky, 2003). From a field study in a context where different professional groups interact on a daily basis, a number of significant results emerged which we brought together in a grounded theory (Figure 5); we took practice sharing between groups as a core category and involvement in networks of practice as a causal condition (Strauss & Corbin, 1990). In the study setting, sharing day-to-day activities (operational proximity) and common values about the organizational unit represents the premise for knowledge sharing between different groups, once participation in networks of practice suggests new or different practices. The presence of 'boundary objects' (patients, documents, and machines) connecting professionals, and the need for continuous training to keep track of the latest advancements in treatments and technology, are the context conditions within which

knowledge sharing occurs. Knowledge flows between different professional groups allow individuals: a) to share, over time, practices that help smooth the work process by enabling actors to formulate solutions beyond their own area of competence, and b) establish operational margins of autonomy when faced with the temporary unavailability of resources (such as the absence of a doctor called away on an emergency) so that interruptions to the work process are limited. The sharing of practices avails itself of individual brokers (Wenger, 1998; Gherardi & Nicolini, 2000), not groups (Bechky, 2003). Moreover, it follows long, composite pathways to diffuse, over time, throughout the organization.

The knowledge sharing that we observed differs from knowledge transformations that occur 'when a member of one community comes to understand how knowledge from another community fits within the context of his own work, enriching and altering what he knows' (Bechky, 2003: 321). We argue that the type of knowledge sharing between different professional groups that we described in fact evokes a new kind of Organizational Citizenship Behaviour (or OCB).

In Organ's definition, OCBs are 'contributions that participants choose to proffer or withhold without regard to considerations of sanctions or formal incentives' (1990: 46). They are extra-role behaviours that do not directly support the technical core but rather influence the social and psychological environment of organizations, which in turn influences the technical core (Motowidlo et al., 1997; Diefendorff et al., 2002).

OCBs can take on different forms in organizations (Van Dyne et al., 1994; Bolino, 1999; Podsakoff et al., 2000). They include: helping behaviours (i.e. voluntarily helping others with, or preventing the occurrence of, work-related problems, such as assisting someone with a heavy workload, helping co-workers with job-related tasks as needed, calling attention to errors, etc.); sportsmanship; organizational loyalty; organizational compliance; individual initiative to engage in task-related activities at a level that is far beyond the minimum, such as volunteering to do extra work; civic virtue; and self-development.

Regardless of the type of OCB, they all require that an actor volunteers to generally benefit her organization (OCB directed at the organization, or OCB-O) or any specific person (OCB directed at individuals, or OCB-I) (Williams & Anderson, 1991). In the latter case, the recipient of OCBs gets help in better performing her own work. Conversely, in the social setting that we studied, the transfer of practices at the boundaries between professional groups is a distinctive OCB-I in that it implies that the recipients are later willing to perform tasks that go beyond their formal duty. According to the process flow design, that in healthcare settings acts as a basic reference in

daily operations, doctors only transmit information to technicians regarding the specific type of immobilization device to make and the treatment parameters. In reality, while working side-by-side, doctors teach technicians how to choose the proper immobilization device from among the available options; they also explain why some treatment parameters are more suitable than others. Likewise, it is technicians who are liable for the proper running and maintenance of the machines. However, in the course of joint activities in the accelerator room, technicians share knowledge with doctors, such as a technician who shows a doctor a procedure that he has learnt from a repair technician for restarting an out-of-order machine.

As a result, these OCBs benefit the organizational unit: they prevent work interruptions by creating the premises for off-setting the rigid division of labour between professional groups. Professionals are willing to 'go the extra mile' by sharing practices with members of different communities and expect the latter to apply such practices in their activities at their own risk, since they all share the same values. Doctors, technicians, physicists, and nurses, in spite of their differences in competence, language, and group identity (Fitzgerald & Ferlie, 2000; Fitzgerald et al., 2002), clearly state their common vision for the radiotherapic unit during meetings and daily interactions. They unanimously acknowledge the core values of their unit as the centrality of the patient and the need to cooperate. Conflicts between professional groups mostly arise when unit identity is at issue. Once social actors reach a convergence in values, these social values serve as benchmarks in day-to-day interactions between professionals and help prevent substantial conflicts and dilemmas.

Morrison Wolfe (1994) argues that whether a behaviour can be labelled as OCB or not depends on the employees' and managers' definition of a given activity as in-role or extra-role. Such actors' respective interpretation of the same activity may differ considerably unless the clarity of formal job descriptions is high. When job descriptions are precise, consensus about job responsibilities tends to be higher than when job descriptions are ambiguous. In a healthcare unit, we claim that members of different professional groups are likely to agree on the acknowledgement of OCBs (for themselves as well as their co-workers) since their job descriptions clearly imply legal liabilities over the treatment phases. In addition, professional groups have different work identities that increase awareness of the boundaries of their own job activities (Doolin, 2003). Consequently, the relevance and strength of the kind of OCBs that we observed grows; not only do they assume that recipients of practices are willing to 'go the extra mile' in performing their duties, but also that they are willing to do so no matter the risk. For a

physicist to autonomously circle the areas of the patient's body not to be irradiated during the treatment in place of the doctor, she must choose to contribute to the unit without regard for sanctions, let alone for formal incentives (Organ, 1988).

Proximity between members of professional groups induces non-specialized language, largely based upon the use of 'deictic terms', such as 'this' and 'here' (Bechky, 2003). Non-specialized language facilitates knowledge sharing that is aimed at making the work flow smoothly. Only rarely do doctors, physicists, technicians, and nurses deal with homonyms (the same meaning for different items) or decontextualization (different terms for the same item) (Gherardi & Nicolini, 2000). The paucity of misunderstandings during inter-group interactions is due to the fact that boundary objects (patients, documents, and technology) are not artifacts created by a single community, and therefore not identifiable as a specific community's product (Boland & Tenkasi, 1995).

Finally, intensity of involvement in one's network of practice does not impede knowledge diffusion between groups. The knowledge exchanged in one's network becomes applicable to one's working context, and is hence useful, if it is shared through working side-by-side. Those actors who participate most in networks of practice do initiate pathways for the transferral of practices that they have learnt elsewhere; these practices then spread, thanks to proximity, throughout the organization.

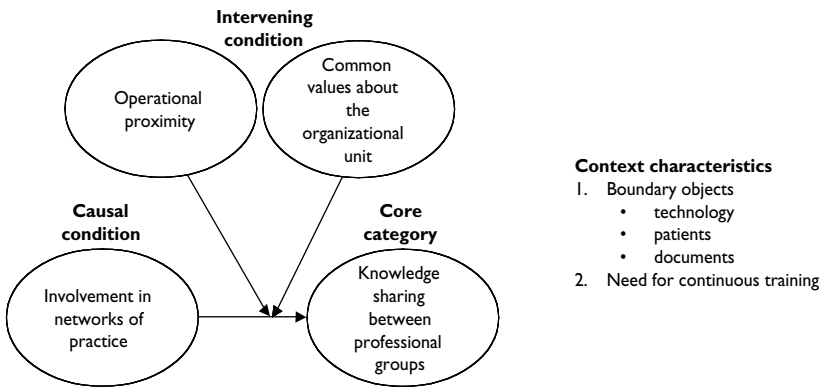

Figure 5 The grounded theory for knowledge sharing between professional groups in relation to the intensity of involvement in networks of practice, common organizational values, and operational proximity

Concluding remarks

Our field study in a healthcare unit shows how both performing daily activities side-by-side and holding common values regarding the unit trigger the sharing of practices among professional groups that participate in different networks of practice. Sharing of practices is aimed at performing extra-role tasks to benefit the organization. In networks of practice members of different professional groups confront, discuss, modify, and learn practices with their peers who belong to different organizations. However, it is operational proximity in combination with value sharing that acts as a leveraging tool for practice sharing in the organization.

We believe that this work offers three main contributions. First, our grounded theory shows a new interpretation of knowledge sharing between networks of practice and links it to organizational citizenship behaviours. Agreement on common organizational values causes social actors to voluntarily transfer their network's practices to members of different professional groups, who, according to the actors, are expected to go beyond their formal duties and perform extra-role activities to profit the organization. Beside those antecedents of organizational citizenship behaviours that are traditionally studied in the literature, such as individual, task, and organizational characteristics, and leadership behaviours (Van Dyne et al., 1994; Podsakoff et al., 2000), value sharing appears to trigger helping behaviours on the active actor's side, which in turn requires the recipient to do the same. The process of reaching a consensus regarding values is troublesome and largely unfolds through the opportunity of working side-by-side. This perspective on knowledge sharing as organizational citizenship behaviour is worthy of further exploration. From a managerial viewpoint, managers should consider whether they provide an ideal setting for value sharing when knowledge is at issue. This holds particularly true for organizations structured around core processes, in which several heterogeneous professional groups intervene (Hammer, 1996).

This first consideration paves the way for the second contribution of this work. Knowledge flows between different groups do not occur fortuitously or homogeneously, but systematically avail themselves of specific actors who act as brokers due to an intense sharing of spaces and activities rather than their own intensity of participation in networks of practice. On the other hand, relations with networks of practice are of crucial importance for confronting and developing knowledge in organizations. It is not sufficient that management promotes the participation of individual actors in the activities of their own networks of practice through financial support for subscriptions to workshops, training courses, magazines, etc. In order for knowledge exchanged in networks to spread within an organization,

operational proximity is necessary. Institutionally planned opportunities for exchange, such as meetings and reports, may not be enough. Organizational design should promote as much operational proximity as possible to create the opportunity for a continuous, intense knowledge flow. This implies retrieving 'old-style' coordination modalities, like mutual adaptation (Thompson, 1967), which has lately been overshadowed by information and communication technologies. Information systems, despite the timeliness and thoroughness of the information they offer, are 'poor' in terms of the knowledge they can convey (Roberts, 2000; Johannessen et al., 2001). Other authors display scepticism as to the ability of information systems to transmit the type of knowledge that is closely linked to a social dimension (for example 'know how' and 'know who'), which needs the co-localization of the actors (Lundvall & Johnson, 1994). We may add that they are insufficient in promoting organizational citizenship behaviours directed at individuals, too, but more studies are needed in this regard.

We do not take tacit knowledge sharing into account, though it is a key feature of communities of practice; we focus instead on the voluntary sharing of practices at the boundaries between different communities. Though tacit knowledge pertains to socially situated knowledge, it is by definition difficult to operationalize and to assess. Another limitation is that we do not measure individuals' identification with the unit under examination (Albert et al., 2000) other than the sharing of common values; doing so may help refine our theoretical framework.

In the end, showing how different professional groups can share practices daily, and showing what role the relationships with peers belonging to different organizations play in knowledge transfers, contributes to the development of studies on a topic that still remains in short supply of empirical evidence.

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Notes

1 From here on, we indicate each member of the unit with a code to ensure anonymity. D stands for 'doctors', T for 'technicians', Ph for 'physicists', and N for 'nurses'.

2 The matrix was symmetrized substituting each cell (ij) with the sum of the values in the cell (ij) and (ji).
3 The standardized intensity of participation in networks of practice for each individual (i) is: $(H_i - \bar{H}_g)/SD_g$, where Hi is the intensity of participation in networks of practice of an individual (i) expressed in hours per year; $\bar{H}_g$ is the average intensity of participation in networks of practice of the group the individual (i) belongs to, expressed in hours per year; SDg is the standard deviation of the intensity of participation in networks of practice of the group the individual (i) belongs to.
4 The histogram does not include the data relating to the three trainee radiotherapists and the two trainee physicists whose level of training activity and general participation to their network of practice is necessarily very high.

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