ARTICLES

The role of hybrid communities and socio-technical arrangements in the participatory design

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Abstract

This paper highlights the importance of "hybrid collectives" in the design process. In the first part, the active role of technologies and broadly speaking of non humans, in the construction and the functioning of those collectives, is emphasized: they allow heterogeneous actors to coordinate their projects; they contribute to the emergence and the transformation of social identities; they help to frame the spatial and temporal settings in which these collectives exist and act; they are directly engaged in action and cognition. For all these reasons non humans are to be considered as strategic players in the dynamics and the organization of these collectives, and in particular of design communities. Symmetrically, the very existence of hybrid collectives induces a new vision of human agency, that must be considered as diversified and variable: needs, demands, expectations, feelings, capacities of action and cognition depend on the socio-technical configurations of their environment, i.e. of the collectives they are part from. Finally some general lessons for participatory design and information ecology are drawn from the recognition of the centrality of hybrid collectives in our advanced societies.

Keywords

actor-network theory, human agency, socio-technical devices, distributed cognition and action, hybrid collectives, epistemic community, information ecology

Recent studies on innovation have shown that conception is a critical phase for the success or failure of an innovation. They point out that the linear model in which innovation passes through a series of successive stages from design to diffusion is very exceptional.

Theoreticians of innovation have suggested replacing this over-simplified model by a whirlwind model in which the different phases can no longer be separated (Figure 1). Basically, this means that the user, as well as all the intermediaries in development and production, participate in the design work (Akrich et al., 2002).

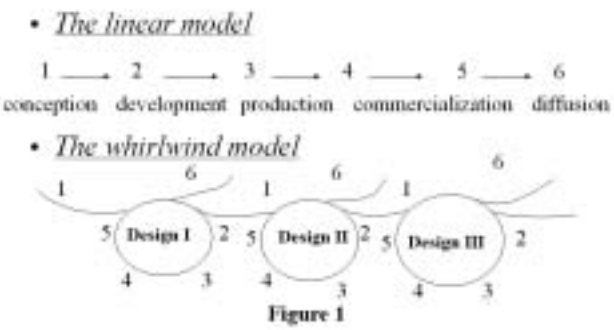

Figure 1

Another feature of the whirlwind model is that design is a never-ending process. Goods and services have a social life; they go from hand to hand and change along the way. Each actor involved reconfigures and reshapes them depending on her needs and conceptions. *Adopting an innovation means adapting it.* This is why it is important for the design work to include all those who are going to be concerned by the innovation, and why it must be as open as possible. The case of open sources clearly illustrates this point. The papers delivered at this symposium provide many examples to show that information and communication technologies (ICTs) help to endow the different actors with an enhanced capacity to participate in the innovation process and its governance.

How is organized this hybridization between design and use? The challenge is to achieve co-operation between groups whose competencies and interests are different and often antagonistic. To describe these new forms of organization, economists and management scientists have proposed a notion that is at the

center of my paper: the notion of community (Amin and Cohendet., 2004) (Knorr-Cetina, 1999) (Lave and Wenger, 1991) (Callon and Law, 1995).

Talking of community means giving up the myth of the brilliant individual innovator and inventor. It means recognizing that users or consumers who express their preferences are not isolated but caught up in social networks. It is collectives that invent, design, develop and use innovations. In fact, more and more often, the same collectives simultaneously take care of all these activities. In order to do so they combine the competencies of different actors. These collectives also contain technical devices and in particular systems of communication without which they would be ineffective. In short, these strange melting pots are a mix of humans and non-humans. I will use the words "*communities*" or "*hybrid collectives*" to denote these new actors of innovation.

These hybrid communities are everywhere (Callon, 2003a). I mentioned open source communities in which users and designers are one and the same, but many other examples exist. With Vololona Rabeharisoa, we have studied organizations formed by patients suffering from very serious genetic diseases. They form collectives in which researchers, clinicians, patients and industry collaborate, and which are at the origin of important therapeutic breakthroughs (Callon and Rabeharisoa, 2003). The profile of these increasingly numerous collectives is as follows :

・Their boundaries never coincide with organizational limits: they generally transcend several organizations (firms, universities, etc.) and, within those organizations, their different departments or units.

・These collectives are cosmopolitan. They include specialists and lay people, professionals, users, and experts from different disciplines.

・Some collectives are highly structured or hierarchized ; others are loosely organized; some aim primarily to produce formal knowledge (economists call them *epistemic communities*); others focus on solving technical problems and developing know-how (these are called *communities of practice*). Very often, they combine both objectives or shift from one to the other.

・These collectives are alive: their boundaries, composition and forms of organization constantly change as new collectives appear, others disappear, and some merge or split up.

・In these collectives non-humans play a key part.

The proliferation of these communities and their increasing role in the dynamics of innovation raise many questions. How can a place be made for them in our societies that tend rather to favor individuals and formal structures? How can their dynamics be accounted for? How can their existence be supported? How can concerned groups or actors be identified and included in these collectives? Which procedures should be implemented to organize the interactions within these hybrid communities? All these questions are important but in this article I will follow another track. I will focus on a more basic and tricky issue.

I would like to suggest here that, to understand the functioning of the communities involved both in designing goods and in defining the needs to be satisfied, we need to give up the traditional opposition between (wo)men and machines, between ends and means, or in other words between human beings and non human beings.

I will examine two points.

First, I will show that the technologies cannot be considered simply as servants or as subordinates. They participate fully in action and cognition, as partners of humans and not as instruments in their hands.

This means - and this is my second point - that we have to revise our conceptions of human beings themselves, of their competencies and of the forms of expression of their needs. What they want, think or feel depends on the configuration of their socio-technical environment. In short, there is a multiplicity of possible kinds of human being. This confirms the value of the ecology of information approach and leads to some practical conclusions for the organization of hybrid communities of design and use.

1. Participation of non-humans in action and cognition

Let's start by examining the status of non-humans. The thesis that I'm going to defend is familiar to some of you, but I think that it's worth presenting it, at least briefly. It can be summed up as follows: Like humans, non-humans and especially technologies participate in their own right in the definition and course of action, and in the production of knowledge on which design is based.

This participation can be analyzed from several points of view.

1.1 Non humans contribute to link and co-ordinate social groups

The first way of describing the social role of technical artefacts is by recognizing that they allow very different groups, sometimes unknown to one another, to establish relations of communication and to coordinate their actions (Bijker et al., 1987). My first research project was on the history of an innovation in the making that can now be considered as largely unsuccessful: the electric vehicle (Callon, 1980) (Callon, 1987). This project, which mobilized substantial resources and many actors in the 1970s, resulted in cooperation between groups whose expectations and needs have until then been incompatible. For example, organizations demanding better and more efficient public transport never imagined they could form partnerships with the car manufacturers against whom they were fighting. Yet once they realized that these firms could support the development of the electric vehicle, they decided to talk to them and work with

them. Progressively the organizations' and car manufacturers' conceptions and worldviews changed. Before the project there was a large number of fragmented antagonistic groups who knew nothing about one another. As the project advanced relations were formed and a collective was constituted — a community of design comprising users, researchers, firms and government officials. What allowed this collective to exist and to develop was obviously the electric vehicle, without which its emergence and development cannot be understood.

1.2 Technologies shape new social groups and identities

But the social role of non-humans is more than that. Not only do transform the relations within society. They also transform its composition, for they contribute to the emergence of new identities and new groups (Akrich, 1992) (Akrich, 1993). Take the case of the cell phone and SMS (short messages of a maximum 160 characters in text mode which are written and received on mobile terminals). One can hardly say that this innovation simply met a communication need that already existed, satisfying it most effectively and productively! In reality it contributed to the creation of new social groups or, as sociologists say, new social identities. Teenagers-with-mobile-phones are for instance profoundly different, infinitely more diverse in their behaviors and desires, than teenagers who never even imagined the existence of this technology.

But the most spectacular effect related to mobile phones, to stick to this example, is the one triggered by relay-antennae in European countries. For complex reasons, people living near these antennae are grouping together to form organizations that oppose the installation of these antennae. They consist of parents concerned about their children's health. Before the antennae and before mobile phones, these groups never existed. They were shaped entirely by this technology. No one knows whether these groups are going to be active for very long, but telecom operators, municipalities and governments have to deal with them. Remove the antennae, the electromagnetic waves they produce, and the defaced landscape they cause, and these groups disappear! The same applies to all the high-risk groups pointed out by epidemiological studies: it is the viruses, microbes and toxic molecules made visible by researchers that cause their emergence and enable them to exist. The circulation of information contributes powerfully to this emergence.

This examples show that new technologies contribute to the emergence of new, non pre-existing groups, which create and forge new individual identities. This is what Marylin Strathern calls proliferation of the social (Strathern, 1999). As shown by many authors, ICTs powerfully contribute to this proliferation (Callon and Law, 2003a)

1.3 Dislocation of spaces and times

Let's go a little further in the description of non-humans and their social role. Non-humans don't only construct and reconstruct collectives; they also transform the spatial and temporal settings in which those collectives exist and act (Callon, 2001).

・It is obviously not difficult to understand why techniques profoundly alter the structure of space. Anyone interested in so-called globalization is aware that the concept of distance has been totally disrupted by the upsurge of information and communication network technologies. We all know that a researcher working in Tokyo can be closer to a researcher in Boston than to her neighbor in the laboratory.

・These technologies also alter the meaning of co-presence. A young teenager in a train who puts his cell phone on the seat next to him, like a kind of impassable barrier, is showing that he's not available for the people around him. He is present in other distant places and absent from the one in which he is physically situated. Information and communication technologies redistribute presence and absence (Callon and Law, 2003b))

・But, more fundamentally, and perhaps less visibly, technologies dislocate time frames. First, in a pretty obvious way: electronic mail, for example, separates the transmission and reception of messages in time. But, more profoundly, ICTs powerfully establish relations between disjoint time frames and create completely new collectives that stretch out in time.

This is best illustrated by a very simple example showing that all technologies, even the most primitive, operate such reconfigurations (that ICTs produce on a large scale). When I was a schoolboy our teacher gave us a proverb to think about every day. One of these was: "Invisible but present beside the ploughman is the blacksmith who made his ploughshare". Obviously the field and the farm were the context for the ploughman's life, but the adage tells us that he shared his life with many other people and things. He was part of a community, we would say now : a virtual community, extending into other places and other times. Question : what is the cornerstone of this set of relations, of this virtual community? Response: The ploughshare transported and circulated through time from one place to another.

This maxim is wonderful. The ploughshare binds the ploughman to all those who designed, produced, distributed and maintained it. The ploughman thought he was working alone, using an ordinary tool intended to multiply his strength and increase his productivity. But no! Thanks to the ploughshare he is surrounded by a silent but real crowd, absent yet present and active. This presence is produced by the ploughshare. Eliminate this humble non-human and the poor ploughman is isolated, helpless, excluded, marginalized and inactive. It is not the ploughman who works but the ploughman + the ploughshare + all those inscribed in the ploughshare, not only the blacksmith but also his forge and his bellows, not only the distributor but his entire logistics.

What the ploughshare does in its own modest way, information and communication technologies do on a vast scale

and with unprecedented efficiency. Collectives spread not only in space but above all in time, and non-humans are the active operators of that extension. Software and search engines on the Web bind me to a multitude of other places and time-frames, to a host of unknown actors who lived before me, elsewhere. They actually produce communities.

1.4 Promissive technologies: distributed action and cognition

So, contrary to general belief, technologies do not produce effects or impacts on preexisting societies. They actively participate in the production of the social. To measure the extent of this reversal, it is useful to introduce the notion of distributed action and cognition that help us to understand the social role of technologies. Since readers are familiar with this approach, I will simply mention a few key points.

・If non-humans, and technologies in particular, participate in action and cognition, it is primarily because action and cognition are collective.

As far as action is concerned, the demonstration is obvious. As we have just seen, ploughing a field is not a solitary action. Driving a car is another action that is accomplished with the participation of thousands of human and non-human entities. When I drive from Tokyo to Kyoto, as soon as I turn the ignition key of my Nissan, I mobilize all the engineers who designed my car, the researchers who studied the resistance of materials, the firms that explored the deserts of the Middle-East and drill for oil, the refineries that produce petrol, the civil engineering firms that built the highways and maintain them, the driving school and its teacher who taught me to drive, the governments that drafted and issued traffic laws, the police who enforce them, and the insurance companies that help me to face my responsibilities. The simple act of turning an ignition key and driving from Tokyo to Kyoto mobilizes an extended network of human and non-human entities that participate, as many and yet as one, in this very ordinary action of transporting me from Tokyo to Kyoto. This action is collective. ANT talks of actants, be they human or non human, to qualify all these active entities participating in an elementary action.

What is true for the action of going by car from Tokyo to Kyoto, is equally true for all other actions and in particular for cognitive activities such as thinking, conceiving, knowing and learning. Hutchins, for example, in his beautiful study of the steering of a military vessel, shows that a fairly straightforward and traditional operation such as rowing a boat to the harbor depends on a complex system of collective cognition: The cognitive task - determining the location of the ship - is performed by a collective, an organized group, and could not physically be carried out by a single individual. And Hutchins' conception of cognition includes not only persons but also instruments and other artefacts as parts of the cognitive system (Hutchins, 1995). Thus, among the components of the cognitive system determining the ship's position are the theodolites used to observe the bearings of landmarks, and the navigational charts on which bearings are drawn with ruler-like systems.

Ron Giere, an American philosopher of science, gives another striking example (Giere, 2002). It is not only practical knowledge that is distributed, but also the production of highly theoretical scientific knowledge, as shown by research on observations made by means of the Hubble Space Telescope. The question that Giere asks is: How is knowledge produced that leads to the assertion that 13 billion old galaxies exist? He observes that there is no one person that can be identified as the cognitive agent acquiring the representation and doing the computation. To answer this question, we have no choice but to talk of a collective or community: It is the collective that observes, thinks, computes and formulates arguments. It is obviously a collective cognition in action. The Hubble collective is nothing without the Hubble Telescope itself, without the computers, without the network of communication. These non-humans play an active part in the production of knowledge; they are not substituted for a human mind, they act, so to speak, as a telescope, as a computer. When I talk of non-humans I must be taken seriously. I don't consider only technical devices. The Abel 1689 galactic cluster, which acts as a lens, is part of the system detecting the distant galaxies. It is not an artefact produced by humans, but a set of celestial bodies out there, that cooperate in the observation. Human brains are connected to a whole series of actants that, with them, produce scientific facts. These actants are distributed in space and in time. Answering the question "How old is the Universe?" is a collective undertaking of knowledge production that, like the action of ploughing or driving a car, mobilizes a host of situated, distributed entities in different times and places.

・Why introduce the notion of distribution and not settle for shared or collective action or cognition? Because each entity, each actant is a source of action in its own right.

To describe this particular capacity that techniques, or natural entities like galaxies or genes have to renew and to re-launch action, specialists in distributed cognition have invented the term "affordance". I don't know whether this word is easy to translate into Japanese, but in French it's quite impossible! My colleagues have got round the problem by inventing a neologism that I think is much richer and more suggestive than the English word. They talk of *promissions*, which is a concatenation of the two words, "promise" and "permission", and a mixture of their meanings. An affordance allows (permission) and suggests (promise) some course of action. For instance, a SMS allows new forms of distant presence for lovers or even for the marketing people and their clients! Electronic maps made available on the dashboard of a car suggest certain courses of action the driver and his passengers would otherwise not have thought of. The same map combined with radio information, and coupled with a mobile phone, will

enable them to imagine new directions, to conceive new activities, to determine the route to follow. The distant galaxy: Abel 1689, coupled with algorithms, makes it possible to see events that no one imagined, and allows certain calculations. The ploughshare, owing to its shape, is also a promission that suggests and allows. Change the shape of the ploughshare and the ploughman does something else. Remove it and he's lost! Without non-humans and their promissions, without "promissive" technologies, a person is as good as dead, no longer existing as a human being. All these non-humans are not inert. Owing to their very existence, their constitution, they cause events to happen that would otherwise have been neither conceivable nor possible. They are active, not passive. ICTs, as it is easy to check, are even more active, more promissive than any other previous technologies.

Let me summarize what has been said by applying it to communities of design. In order to understand the constitution, the structuring and the extension of those communities, technologies do matter because they are active forces. They create coordination, they link existing actors and provoke the emergence of new ones who want to be taken into account. But technologies, or generally speaking: non humans, matter for another reason: they take part in the process of production of knowledge and know-how. Intellectual achievements, ideas, projects, plans, production of information, are through and through material processes. Technologies shape their content.

My first very simple message will be: don't forget to consider these communities of design and use as socio-technical arrangements. They can not be seen as simple associations of humans mobilizing powerful and sophisticated technologies. Technologies, and particularly ICTs, must be considered and managed as authentic actors who shape collectives and open new ways of thinking and acting.

At this point, I'd like to examine my second question, which is symmetrical to the one I've been focusing on until now. In a sense, I've rehabilitated non-humans. I've recognized that they have real competencies and an active role in cognition and action.

But, by making non-humans more competent and more active, aren't we making humans more stupid and passive? I'm now going to suggest that the opposite is true. This redistribution is not a zero sum game. The more we recognize that non-humans have an active social role, the more we enrich human nature. A consequence of the rehabilitation of non-humans is thus the rehabilitation of humans.

2. Human agency

At the beginning of my paper I mentioned the great divide that the social and natural sciences had created between humans and non-humans. Their concern - which is understandable from an ethical point of view - is to separate human beings from the rest of the world.

Thanks to paleao-archeologists we know now that such a neat and clear divide does not exist. For example well-trained primates can enter into sophisticated symbolic communication; they can conceptualize differences between the beings surrounding them, and conceive of themselves as different. There is no distinct boundary between those beings that we consider as humans and others considered as being deprived of humanity. In reality, there is a continuum or rather a vast diversity of configurations that correspond to different ways of being human or being non human (Picq, 2001) (Serres, 2001).

To describe this diversity the key concept is the English concept of agency. This word denotes the capacity of any being to act, think and experience emotions. The definition of needs, the expression of demands, the preferences for certain goods and uses, are also strongly related to agency.

There are obviously several modes or forms of agency, since there are several ways of acting, thinking, feeling and expressing needs (Moser, 2003). We must refrain ourselves from making assumptions on an eventual specificity of human agency. We should rather consider that there might be several forms of agency within what is known as humankind. The characterization of these different forms is a matter for empirical study and not for metaphysics.

Not only are agencies diverse and multiple, they are also subjected to evolution and reconfiguration, depending on their environments. Put me into the collective Hubble and perhaps I'll make shattering discoveries; take me out and I go back to being an ordinary sociologist who's having trouble imagining the origins of the universe! The agency of any human being, his ability to conceive of actions, to plan them and to accomplish them by following the plan; the ability to have ideas and to associate them; the ability to be moved or gripped by compassion, the capacity to define his expectations and needs, all that depends on the arrangements, the socio-technical niches in which she or he is situated. This observation is the consequence of what I said earlier on about collectives, and in particular about distributed action and cognition.

To make myself clearer, I'll take an example from daily life. The motor car is the emblem of the modern world and the car driver is one of its heroes.

Motor car drivers are generally individual human beings whose agency depends primarily on the socio-technical environment designed for them, and in which they find themselves. Designers have imagined a host of different configurations. Just to illustrate the diversity of human agencies, I'm going to distinguish two that are contrasting extremes.

The first arrangement is intended to produce an active, autonomous driver, that is, one who is capable, on his own, of determining the decisions he's going to make. A list of alternatives is available to him; he controls all necessary information for preparing his decisions; he is now capable of seeing beyond his visual field, as such, and of anticipating the

long term; and, last but not least, he is responsible for the consequences of the decisions that he took with full knowledge of the facts (think of accidents). Moreover, this being experiences particular emotions that are related to his autonomy, to his self-control and to the control of his environment. He delights in his power and freedom, and challenges other drivers, for the pleasure of existing is sometimes, for him, synonymous with the risk to die. The speedometer measures the intensity of his emotions. In short, he is the model of the free and autonomous subject, active, enterprising, defining goals and fighting to achieve them. He is self-mastering.

This model is becoming dominant in our societies. But admit that this profile is neither natural nor universal! This self-mastering individual is a highly prosthetic human being. To act, to think, to make decision, to be an autonomous subject, he co-operates with algorithms, technical assistants, road infrastructures, satellites, GPS, complex and advanced system of communication. You can easily imagine the huge quantity of information to be obtained, collected and processed, to feed and to produce this improbable and highly artificial being: the self-mastering, individual and autonomous driver. Remove his GPS, his dashboard, road signs and signals, maps, in short, the arrangement that shapes his agency, and he becomes awkward, incapable of choice and autonomy. That's the paradox: the free and responsible individual, versatile, capable of devising projects, is a being equipped with multiple prostheses and human or non human assistants; a being manufactured from scratch and in no way a being of nature. What the driver, as any other self mastering subject, can, wants, thinks and feels, depends on environments that are created by engineers, town planners, local politicians, briefly, by a host of other agencies, themselves equipped with prostheses and empowered.

But this form of agency is not the only possible figure. Engineers and politicians imagine other forms. Some consider, for example, that in the long run the free, autonomous and responsible driver will be a source of problems: pollution, traffic congestion, accidents or global climate change. Basically, they think that it's not a viable species. Hence, the idea of switching to another form of agency. The driver is no longer maintained as a self-mastering individual. Sophisticated technological devices, mainly based on ICTs, take care of him, decide on his behalf, and frame his behaviors. What is shaped here is a passive agency, a driver who depends on choices made for him by complex but intelligent technological devices. The driver allows himself to be transported by the arrangements. The speed of his vehicle is set according to the traffic and the speed limits of the area in which he is driving; the distance from the car in front is controlled by an on-board computer. He is still the driver, but many of his competencies have been delegated, transferred to the actants incorporated into the car or situated in the road infrastructure (Latour, 1996). He can let go, think of other things, may be send SMS; he needs no competency, no moral judgement. The arrangement is competent and moral for him. His body, brain, muscles and genes are not necessarily different from those of the self-mastering driver, but he's no longer the white Western male framed and enacted by the first option even if he is as artificial as him. On the contrary, he lets himself be transported and enjoys this active passivity!

Hence, the slogan I propose: change the collective, change the socio-technical arrangement, and you change the agency. You obtain another form of human being. As suggested by the example of the car driver, the role of information technologies in the shaping of these agencies is central. Without them, this shaping would be much less efficient. But ICTs contribute also to increase the variety of possible human agencies. I would dare to say that, in the future, coupled with genomics and biotechnologies, ICTs will make realistic to start off from human diversity to customize agencies.

I have taken the example of the car driver because it corresponds to our everyday lives and experiences. But the existence of diverse forms of human agencies is the rule. In a book that I've recently published I show that what applies to the car driver applies equally to the economic agent (Callon, 1998). Myriam Winance has even extended this analysis to handicapped people (Winance, 2001). We are all handicapped in some or other way, because we are all different. The question is not that of disabilities but of the socio-technical shaping or, if you prefer, the design of abilities (Moser, 2003) (Callon, 2003b). Lucy Suchman has given a very original analysis of wearable technologies that equip the body with a sort of artificial skin allowing faster and more precise reactions and interactions with the environment. She says that intelligent technologies will propose in the future even more personalized and diversified forms of agency (Suchman, 2002).

This vision of human agency has many implications and raises a number of questions. Here are some of them.

・Human agencies can be formatted. Accordingly, we cannot talk of cognitive and emotional capacities or of modes of action that would be peculiar to human beings.

・Human agency is diverse: Its characteristics depend on the socio-technical arrangements to which it is articulated. It exists in different forms of autonomous, quasi-autonomous, passive or passionate individuals. But these are only examples, and there are many others to explore like the shaping of collective agencies.

・Designing an innovation or a technology means participating in the shaping of new agencies or in the reconfiguration of existing ones; it doesn't mean only responding to demands or to satisfy needs.

・Debates on agencies, and consequently on forms of arrangements and on the innovations that we want, are under-developed. For example, we consider that economic agents are homo economicus and we format markets so that only this type of economic agency prospers. But there are thousands of other

ways of being economically rational. We must be aware that when designing ICTs what is at stake is the type of human agency, of human being we want to develop.

3. Concluding remarks

All this may seem exotic and without any immediate relation to the question of participatory design. To conclude, I would nevertheless like to argue the opposite.

Let me revert to my starting point.

Everyone agrees that design is a decisive activity not only in the economic battle but also in the determination of our lifestyles and in the construction of our future world. Everyone knows and recognizes that design work is less and less often separate from development and production. Furthermore, use and design merge, or at least constantly interpenetrate each other. The corresponding social roles become hybrid; any designer is a user and vice-versa. This hybridization creates communities consisting of actors with different competencies and sometimes antagonistic interests and conceptions. These collectives are made and unmade. They appear, spread, diffuse throughout organizations, merge, and sometimes disappear. They are the key actors of our innovation societies.

Participatory design highlights one of the key characteristics of these collectives, the fact that they trigger collaboration between all those concerned by innovation. No success, no social acceptability, without participation, without representation of actors concerned by innovation, of producers, intermediaries, political authorities and end users.

Once the importance of these different collectives has been recognized, we need to further our understanding of their functioning. That has been the object of my paper.

I suggested, that this understanding involves two departures from common sense and from our view of relations between technologies and societies.

To study these communities, we first need to recognize that technologies have a capacity for action in their own right. Without them our societies would collapse. There would no longer be either action, or thought, or cognition. And this is all the more true since ICTs are concerned.

The consequence, and this is the second departure I'm suggesting, concerns the definition of the human actor. Instead of considering him as a being with specific qualities and characteristics, with a clearly-defined identity, I have shown that we need to represent her or him as an agency with a variable and diversified profile, shaped by the arrangement, the collective in which she or he lives.

In terms of participatory design two general lessons can be drawn.

First, when one thinks of participatory process, we spontaneously consider participation of human actors. Then the emphasis is put on the information which is available to them. What I've said underlines the limits of such an approach. We must place at the center the hybrid, socio-technical collectives without disentangling human and non humans. These communities constitute a new category of actor, which must be organized and studied as such. These communities can not been reduced to the individuals who constitute them; and they can not be considered as pure associations of human beings who communicate one to each other.

Second, to conceive new technologies, new goods and new services, is not just a question of satisfying needs or demands expressed by well-identified human beings. It is also and mainly shaping new forms of human agencies and consequently constructing new types of collective life. The main challenge for the next years will be to discuss which type of human agencies people want to develop. Or, in other terms, which types of socio-technical arrangements people will design and experiment. This is a key issue for participatory design of information.

The tricky thing is that human agencies who will imagine and design those arrangements that at their turn will transform human agencies, are themselves equipped, dependent on their socio-technical environment. Put it briefly, humans depend more and more on the socio-technical arrangements that depend on them. It's this cross-over that defines the human nature of human societies (Serres, 2001). But that is also what has to be recognized, analyzed and organized. My conviction is that, given the importance of ICTs in this cross-over (they transform our nature by transforming our environment and vice-et-versa), the approach in terms of ecology of information will contribute towards a better understanding of those collectives, the agencies they format, and hence the creative capacities they spawn, as well as the demand they generate. The more civilized society that everyone hopes for requires the recognition of the increasing role of these hybrid communities.

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