

Innovation in the making: performativity and enrolment in the innovation process

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Abstract

A processual ontology has penetrated the understanding of many organizational phenomena, such as innovation. Contemporary considerations on innovation have focused on its development over time, as a journey taken by organizational actors leading to an open range of outcomes. Nonetheless, such perspectives do not fully capture the processual nature of innovation: they still rely on a vision of actors involved as *faits accomplis*. Along these lines, the paper offers an alternative way to look at an evolving phenomenon – innovation - in process terms. Our research enriches contemporary investigations on innovation by introducing the concepts of enrolment and posthumanist performativity in the analysis of innovation, and by empirically exploring the entanglements of matter of different kinds and their influence on the making of innovation. Such intra-activities are illustrated through the use of data derived from an ethnographic study in a pharmaceutical not for profit research centre.

Introduction

Recent elaborations of innovation have been focusing on aspects such as the different ways of emergence of innovation, its development over time in different organizational contexts, and its termination or implementation phases (Van de Ven et al., 2008; Van de Ven, 1986; Slappendel, 1996; Van de Ven and Rogers, 1988). These approaches preannounce a vision of innovation that refuses a “stage-wise” model and embraces a dynamic view of innovation. Here, the processual nature of innovation is bound to interactions of “people who engage in transactions (relationships) with others in changing institutional and organizational contexts” (Van de Ven et al., 2008:6). In this sense, viewing innovation as a process recalls attention to the dynamics of interactions that continuously evolve over time (Van de Ven and Rogers, 1988). Such interactions encompass structural and individual levels, so that innovation is formulated in terms of a web of interconnections progressing in time.

However, framed in these terms, innovation is anchored to on-going interactions among human discrete entities. Here we argue that an emphasis on human interactions over time does not sufficiently grasp a process metaphysics (Langley and Tsoukas, 2010, Langley et al, 2013) and does not offer a comprehensive understanding of the processual nature of innovation. Specifically, Van de Ven’s (2008) definition of innovation that results in its elaboration of interactions as constitutive of innovation, presupposes the existence of *a priori* entities – ideas people, transactions, outcomes, and context – which accordingly are considered “faits accomplis” and pre-constituted entities. Conceiving entities as ontologically constituted *a priori* of the phenomenon, however, is problematic because it limits the possibility to unveil the intra-activity of elements involved in the making of innovation; elements that are instead performed by the phenomenon they ought to constitute.

Following these considerations, the paper addresses critical elements arising in Van de Ven et al. (2008) process metaphysics by proposing a theoretical shift in the foundation of the processual nature of innovation from interactions among people over time in a specific institutional and organizational context, to the performative and enrolment dimensions of innovation. If taken in process terms, innovation can be seen as a phenomenon formed and emerging through intra-actions of actants, whose entanglements contain a performative dimension. Specifically, the concept of enrolment (Akrich, 1992) can help understanding two levels of performativity in the innovation process: the innovators’ inscription of a framework into objects, and a process of de-description from the users’ side of the technological object. Furthermore, these two elements emerging in Akrich’s elaboration of “enrolment” recall two

different types of performative dimensions found in other articulations of performativity such as that of Barad (2007): a human's performativity in the shaping of the technological object and an object's performativity on agents, through their ability to convey meanings interpolated in them. In order to better understand the making of innovation, it is hence crucial to explore the role the performativity of objects plays in its unfolding.

The paper seeks to contribute to the formulation of innovation in processual terms by focussing on the performative dimensions of this process; on the flow of actions from various actants; and their unfolding entanglement over time. More specifically, the paper provides examples of the inseparability of the material and social (Orlikowski, 2007) in the phenomenon analysed.

By looking at the sociomateriality of innovation from both a sociology of science and technology and an agential realist perspective, the paper contributes empirically to recent debates (Leonardi, 2013, Mutch, 2013, Orlikowski and Scott, 2013) on the lack of research in organizational settings undertaken by scholars engaging with such viewpoint. As Scott and Orlikowski (2008 and 2013) emphasize, taking sociomateriality from an agential realism perspective for further empirical deployment in the study of information systems and the like is still in its infancy.

In this light, the paper engages with Leonardi (2013) and Mutch (2013:31) critiques of Barad's viewpoint as one which does not provide a detailed account of materiality and disregards broader social structures. The paper argues that such a critique to Barad's perspective is misleading as Barad (1996) explicitly refers to the importance of considering social dimensions within which the phenomenon takes place, as she affirms scientists and matter (such as light waves) never operate in a vacuum, but refer to a larger context, a theoretical one for the scientists involved or a bodily apparatus for the matter (i.e. waves) involved in the phenomenon. The paper replies to these critiques by offering illustrations of the application of Barad's stances specifically to the making of innovation. By analysing this perspective in conjunction with that of Akrich (1992), the article seeks to offer a theoretical angle through which innovation as a process can be depicted in its entirety through the highlighting of the entanglements of different types of materiality. In light of this viewpoint, by considering the wholeness of the phenomenon, priority is given neither to the material nor to the cultural (Barad, 1996).

Performativity and enrolment in the innovation process

When Akrich (1992) outlines the concept of enrolment, she refers to a process in which an object is constructed by a variety of forces enacting some sort of action on it. Akrich denotes two key aspects involved in this process. Firstly, she considers enrolment as the expression of the objects' embodiment of relations among different elements. Enrolment in this articulation contains sets of "multilateral negotiations" (Callon, 1986: 211) among actants. Secondly, a notion of action pervades this process. Agency becomes central in Akrich's visualization of the process of enrolment of objects: objects contain (embody) and at the same time "measure" sets of forces (relations, networks) existing among elements. For Akrich objects are at the same time containing and constructing relationships among actants. Again, agency plays a central role in this definition. Furthermore, Akrich (1992) questions the roles objects play in this construction and embodiment of relations, attributing agency to objects in two senses: on one side objects constrain actants in their relation to the objects themselves and to other actants; on the other, these networks among actants perform (reshape) objects and their use. This is consistent with Barad's (1996) agential realist view for which non-human matter enacts agency:

"There are three important points that we can take from this passage: (i) nature has agency, but it does not speak itself to the patient, unobtrusive observer listening for its cries – there is an important asymmetry with respect of agency: we do the representing, and yet (ii) nature is not a passive blank slate awaiting our inscriptions, and (iii) to privilege the material or the discursive is to forget the inseparability that characterizes phenomena." (Barad, 1996:181)

These key points are useful if taken and adapted into the innovation domain. In fact, enrolment in this dual connotation highlighted previously allows for a better understanding of innovation in process terms. Moving from Akrich's first conception of enrolment, objects enrol networks among actants. It is interesting to notice how objects (technological, material, discursive) are part of humans' relations with one another and with objects themselves, in the making of innovation. Here it could appear that innovation is taken as a context, rather than the centre of the analysis, with innovation providing a context in which actions occur; nonetheless, innovation is the necessary process through which relations among actants emerge. Furthermore, the innovation process contains a performative dimension as it results from these relations (networks) but also (re)configures these relations.

Some important issues are raised here: what are these relations about? What actants are involved in these networks; and how do they constitute them? Furthermore, how are these

networks constitutive of actants? Following this and taking into consideration Akrich's second articulation of enrolment, the focus moves on to actants and their networks as constitutive of the innovation process itself through the ways they define materiality of all kinds but one that plays a role in shaping and making innovation and in setting constraints to the innovation process.

To summarize, enrolment as an analytical viewpoint nurtures an understanding of innovation grounded on the different roles of objects and of networks among actants shaping their reality and defining the innovation process. It also puts **agency** at the centre of attention in the making of innovation. In this sense the notion of enrolment enriches the analysis of the ways the innovation process and the actants involved in it are mutually constitutive. This makes the concept easily connected to the idea of performativity. We see from this how both Madeline Akrich and Karen Barad discuss extensively the performative dimension of human and nonhuman agency, even if in different terms. Before entering further into a comparison of their analytical framework, however, two considerations need to be made. First, whose agency is to be discussed and is it human, nonhuman or something else? And secondly, why is performativity central if we want to understand innovation in processual terms?

Akrich and Pasveer (2004) elaborate an analysis of the performative dimension of technology and medical practices on the pregnant body. Their approach is centred on the elimination of the Cartesian scission between body and mind, materiality and emotions, the body and the self ("embodied self" is the term used to reduce this dichotomy). They also refer to the importance of unfolding and identifying different entities involved in the making of a phenomenon. While in their study that is the childbirth experience, this can be extended to the case of this paper: the innovation process. It can be therefore argued that such entities are crucial in the making of innovation, with innovation defined as the result of the "relations between various entities, themselves defined through this process" (Akrich and Pasveer, 2004:65). The common ground with Barad's performativity is firstly a notion of agency that pervades both Akrich's enrolment and Barad's performativity, and secondly a rejection of the existence of "faits accomplis" (Langley and Tsoukas, 2010) as constituting a phenomenon.

Barad's performativity refuses representationalism thus taking into account Actor Network Theory's and Butler's ontological stands on the rejection of *a priori* constituted entities, and is hence similar to Akrich's perspective. In Barad's view, that resonates with that of Butler, identity is a doing and not an essence; there exists an elimination of the contraposition between agency and structure; it understands subjects as historically constituted (as iterative

citatoriality, which Butler derives in turn from Foucault); and emphasizes regulatory practices (a constitutive outside). Nonetheless, Barad highlights a key missing point in Butler's view: the consideration of matter's dynamism. In Barad's opinion, Butler limits matter's historicity as derived from agency of language and structure. Barad (2007) rejects this, as it assumes that matter is merely a product. Instead, she sustains, materiality needs to be enhanced and brought into the discourse on power, as materiality plays a crucial role in its workings:

"What is needed is a robust account of the materialization of all bodies – "human" and "non-human" – including the agential contributions of all material forces (both "social" and "natural")." (Barad, 2007:66).

Agency here is the node of our understanding of phenomena and the separation between human and non-human (agency) has to be clarified in relation to Akrich's stance. Agency, for Akrich, is the action undertaken by actants -or to which actants undergo. Actants are for Akrich of various types; they are heterogeneous elements. Here the link between Akrich's and Barad's perspectives on agency becomes clearer: Akrich's heterogeneous elements can be seen as Barad's (2007) "agentially intra-acting components". Both terms are founded on an understanding of agency as constituting them. According to these two perspectives, intra-relating elements contribute to - and are part of - the phenomenon: "phenomena are the ontological inseparability of agentially intra-acting components" (Barad, 2007:33). For Akrich (Akrich and Pasveer, 2004:68), the body, actors, the mirror, etc., constitute the phenomenon "as an acting entity". Accordingly, for Barad (2007:197), "phenomena are physical-conceptual (material-discursive) intra-actions whose unambiguous account requires "a description of all relevant features of the experimental arrangement".

In conclusion, for Akrich and Barad, materiality – of any kind – is central in constituting a phenomenon. Similarly, this materiality comprises not only the human body, but also the non-human. Akrich and Barad's ontological stands critically question the distinction between human and non-human objects as part of the action. For Akrich the separation of the two is problematic: in her analysis of childbirth narratives, she notices how non-human objects are entangled with the human; moreover, she implicitly claims an ontological absurdness of such separation. For Akrich it would be paradoxical to disassociate the delivering body from the embodied self of the woman and from the intra-acting elements that constitute it. Likewise, Barad's agential realism rejects the separability between social and material (Scott and Orlikowski, 2013), as it is based on a non-essentialist view of phenomena and on the entanglement between technology (materiality) and social structures. Combined together, these two theoretical frameworks can shed new light on the understanding of the elements

implicated in the evolving of innovation (Langley et al 2013). Specifically, and this is the key point of departure from Van de Ven's view, the nature of this evolving phenomenon is processual not due to its temporality in longitudinal terms, but to its reiterative forming and performing through the intra-activity of elements, which are never accomplished but in continuous motion in their making.

Data collection and data analysis strategy

The two theoretical perspectives of performativity and enrolment are here compared through the use of data collected via a “methodological bricolage” (Marcus, 2009) of participant observation and semi-structured interviews. Specifically, the data utilized in this paper refers to three months participant observation in a biomedical research centre based in Italy (Institute for Pharmaceutical Research, IPR). During this period, 21100 words of field notes, videos and documentary materials were collected. Additionally, 25 semi-structured interviews were conducted covering all levels of hierarchical structure: head of department, heads of laboratories and units, senior and junior researchers. All data has been fully anonymized, names used in the paper are fictitious, but quotes of interviews and documents are translated and reported verbatim.

The data has been analysed through the lens of a constructivist grounded theory (Charmaz, 2006) approach. This perspective helped focusing on the processes emerging from the data; specifically, actions were the units of analysis. As Charmaz (2006) highlights, constructivist grounded theory is not to be understood as a tool for developing theories from data (as formulated in the traditional version of Glaser and Strauss). Rather, Charmaz's perspective envisions theories and data as a whole, where theory is embedded in the data and data is not separate from theoretical stances, but as elements that simultaneously construct reality. For Charmaz (2006:15), “[...] what we bring to the study also influences what we *can* see.” Hence, in the process of data analysis, an awareness of the implications of the theoretical claims motivating this research has been raised and particular attention has been dedicated to the attempt of allowing data to drive theoretical assumptions. To summarize, it is here believed that a purely inductive approach is never reachable as theoretical frameworks guide the attention of the researcher towards specific aspects of data both at the process of collecting them and at the analysis stage.

Secondly, adopting a constructivist grounded theory approach is fruitful in the analysis of the data collected as it implies a closer attention to processes, rather than offering a putative description of the setting. Indeed, the interest here is on how the phenomenon, the innovation,

is formed in its making, rather than offering a description of the elements constituting innovation and the steps necessary for its achievement. By using this view of grounded theory, the processual nature of the phenomenon is therefore enhanced. Strauss and Corbin (1990) often discuss the importance of processes to be included in grounded theorizing. But it is only with Charmaz (2006) that this recommendation has been taken further. Hence, this approach brings into light incidents that become crucial in the making of innovation. If left to this stage, the analysis can encounter what Langley (1999) identifies as the central critique to this strategy: its drowning in the micro level of emotions and interpretation. Nonetheless, as Strauss and Corbin (1990:11) sustain, grounded theory needs to focus on the “broader structural conditions” bearing the phenomenon, so as to highlight the linkages among these conditions and the actions taken by the actors involved. In this way, the broader picture of the whole dynamic coming together of the innovation process is described. By contextualizing the phenomenon, the complexity of the phenomenon is solidified in its entirety and the numerous elements acting and embodied in the phenomenon, which emerge through a constructivist grounded theory approach, congeal in the wholeness of this contextualization.

The data has been systematically analysed by using SQR Nvivo 10. Interviews were firstly coded incident by incident and secondly an axial coding was made so to connect subcategories into categories: conditions, actions/interactions, and consequences of the phenomenon were identified at this stage and resulted in the summarizing table discussed in the next section.

Empirical setting

Institute of Pharmaceutical Research (IPR) is a not-for-profit biomedical research organization based in Italy. IPR was founded over 50 years ago as a centre independent from industry, universities and the State. Regardless of being a private organization, it serves the public interest and its results are never patented but published, hence freely available to the research community.

IPR is located in four areas: three in the northern region and one in the south of Italy. Overall, IPR employs 900 people, of which less than 100 in the locale followed for the research presented in this paper. IPR works on several streams of medical research and comprises ten different departments alongside with four additional laboratories. Its research spawns from biochemistry and molecular medicine, to bioengineering, epidemiology, renal medicine, neuroscience, oncology, cardiovascular medicine, public health, and computer engineering.

The IPR locale investigated for the research presented here is situated in a science park in the north of Italy, in a new building which provides IPR researchers with advanced technical equipment for their projects. A sense of pride of being part of IPR was widely observed among IPR researchers, with a particularly strong sense of value stemming from the importance of doing not for profit research for innovation purposes. Strong passion, commitment and professionalism are some common characteristics of the members.

All members interviewed and observed positively welcomed this research and offered useful insights on their daily practice. They belonged to the biomedical engineering department, renal biophysics laboratory, cell biology and regenerative medicine laboratory, gene therapy and cellular reprogramming, experimental models of kidney diseases, pathology and immunopathology, and molecular cancer therapeutics laboratories. Subjects of the participant observation were affiliates of the tissue engineering department, mainly young female biologists and engineers.

Members in IPR are mainly female biologists, with a minority of engineers and doctors. Most of the personnel have arrived in IPR at the early stage of their career, mainly as graduate students working on their thesis and subsequently continuing their career in IPR with further academic developments (PhD) or for a funded research project.

Analysis of empirical material

Through the analysis of interviews, observational and documentary material, three key constitutive aspects of the innovation process have been identified, as summarized in the table below.

Matter constitution	<ul style="list-style-type: none"> • Configuring matter through its naming • Constitution of an embodied self • Incorporating outer materiality
Matter entanglements	<ul style="list-style-type: none"> • Matter performativity on body and self-embodiment • Materiality at the centre of relationships
Structuring conditions	<ul style="list-style-type: none"> • Creating an innovative environment • Identity performativity of a non-profit in the Italian context

Figure 1. Performative dimensions of the innovation process in IPR

The first aspect of enrolment and performativity identified in the analysis of IPR data is the process of naming or describing materiality, whether human or non-human. A second is

enacting work practices. The third is structuring conditions for this process. These three processes are not separated from each other: the ways materiality is defined by human actors, either as materiality perceived as external from the individual or one which is identifiable as an “embodied self” (Akrich and Pasveer, 2004), is not separated from their doings, their daily work practices or the conditions that frame these processes -tacit or explicit norms at the organizational and institutional level. All these elements, it will be argued in the next sections, constitute as a sociomaterial whole the performative and enrolment aspects of the innovation process.

Matter constitution

Taking into account a post-humanist performativity leads attention to practices, doings or actions in the analysis of the phenomenon. Following this perspective, it is crucial to recognize the human and non-human in “everyday social practice, scientific practices, and practices that do not include humans” (Barad, 2007: 32). The link between materiality and performativity is also evident in Butler’s formulation of performativity as a “reiterative and citational practice by which discourse produces the effects it names” (Butler, 2004:2). For Butler the body is material, but its materiality is the effect of power discourse. Part of the analysis offered here highlights this articulation of materiality as profoundly relying on power of discourse, and agency as not a single action but as a repetition of actions which “conceals or dissimulates” the norms and regulations it repeats (Butler, 2004:12). In this sense, for Butler, discursive practices produce what they name. Citationality is similarly found in Barad (2004), as she draws on Butler’s assertion on the nature of discursive practices as constitutive of matter. Nonetheless, Barad’s main contribution in this sense is to bridge discursive practices and matter closer together and to highlight matter -and not only discourse- as central in the process of materialization

Configuring matter through its naming

Naming materiality means to give a form to matter, to shape it, in a sense, to produce it. Thus, discursive practices play a role in producing materiality. This action is a performative stance, but also an enrolling one, in Akrich’s terms, as matter in this way in-scripts the agent’s framework and sense of the object. Specifically, performativity means to give a name to materiality: defining materiality results in shaping and producing it. The object’s performativity resides in containing the inscription of a framework which is expressed by the ways actors define and talk about objects. Vice versa, the agent’s performativity lays in the

de-description of this framework of the object; such framing is contested/modified/reaffirmed by the actor's repetition of the naming of objects.

Different elements concur in the making of innovation. Institute of Pharmaceutical Research is an interesting context in which producing innovation is an everyday activity. IPR has been involved in biomedical research for over 50 years, working on the understanding of the causes of renal disease failures and providing alternatives to dialysis and transplantation, on the prevention of diabetes complications, and to investigate rare diseases, among others. For IPR researchers, making innovation evolves in their daily practices. Not only these practices, but also matter itself plays a crucial role in the possibilities available to the researcher to develop and implement new techniques and carry on experiments crucial in creating innovation. The enrolment framework found in the ways IPR researchers define matter is one that comprehends materiality both as an external but yet internal entity. Matter is defined by IPR researchers as an object which has a pre-constituted essence, as this passage outlines:

“I am on the cells area and of course also on the part of characterization of these IPF cells. As they are staminal cells they are also semi-tumour cells which proliferate very quickly, they can give different cell types also spontaneously hence they are cells to be controlled, not cells to use casually. Hence you need to characterize them with a particular method. Then after doing all this part which is not easy, because you need to find the area in which they integrated....” (Sandra, researcher in IPR).

Three elements emerge in this excerpt. First, materiality is defined as external, as an entity which proliferates outside us, almost in a vacuum, as if the context in which it is located had no influence on its form. In fact, there is no mention in Sandra's definition of IPF cells of a medium or liquid or any sort of condition in which these cells are developing. More importantly, materiality can be managed, controlled. This presupposes an agent who engages with materiality and establishes a relationship, a network with it. Hence what becomes critical here is the agent's definition of matter as external; nonetheless this externality is quite vague as matter reveals to be intrinsically internal when enacted in work practices. Later on Sandra spots again this aspect of materiality when clarifying aspects of polymerase chain reaction's components:

“The components are few, you can play¹ with them, but you need to know what to touch, for me the mastery of technique is everything.”

The actor possesses the object and at the same time manipulates it accordingly to their research requirements. To manipulate is hence an art of the researcher which involves

¹ Sandra uses the Italian word “giostrare”, which means both to take part of a tournament (hence to play) or also to fumble, to fight. The sense given here is to manipulate the object in different ways.

materiality in its complete extent: its composition and properties. The researcher's appropriation of matter eludes its ontological separation from the agent involved in its "manipulation". Matter has been described by several interviewees in terms of appropriation, as Gabby does when she refers to the behaviour of cells:

"Maybe your cells answer differently from mine" (Gabby, IPR researcher).

As it emerges from this passage, materiality has agency in a double sense. Cells are owned by the researcher who defines them as "mine" or "yours". In this acceptation matter becomes a way to differentiate between the self and the other. Hence matter's agency is one that brings together or separates individuals (groups, units of the labs) along with a vision of agency also found in matter's ability to react to the researcher's manipulation. This point rejects Leonardi's (2013) claim that material agency refers only to the action of objects "provoked" by humans. Thirdly, matter's dynamism (Barad, 2004) is evident in its being not only the object of study but also the element that defines the researcher's identity.

Matter embodies, contains elements, networks of actants. This is, according to Akrich (1992), one facet of matter's performativity. Matter contains, embodies networks of actants in the sense that it is through matter that actants define themselves. Further, objects constitute networks of actants as they become the contentious of researchers' relationships but also the element of engagement from the researcher's side. An example of this inseparability of human and non-human matter emerges in a discussion with Helen, an IPR technician, when she describes both implications and requirements for dealing with umbilical cords. Matter is handled, manipulated, shaped each time it interacts with the human. Reciprocally, the biomedical researcher's identity is formed through their intra-actions with other types of matter. In this sense, Barad's "intra-actions" is a useful concept to highlight the entangled formation of identity. As Helen narrates, working with cells presupposes a specific attention to procedures of handling matter and of enacting bodily acts: all instruments and the environment need to be possibly entirely sterilized (specific hoods are used when for example Helen extracts cells from the umbilical cord). Once used, all instruments, test tubes, and liquids are to be thrown away in bins which report a "biological contaminated residues" label. Additionally, in IPR only few people can access cells laboratories and before doing so researchers are required to specially wear shoes protectors (some workers have sandals they use only in specific rooms), a white coat (or a green disposable one), and gloves which are located inside the labs. This dressing procedure takes place in the first room at the right side of the cells labs entrance, where lockers are located. All these norms are rendered explicit

through a document new entrants receive the day of their arrival, stating general rules of conduct for safe behaviour in all laboratories. The norms for “laboratorians” (as researchers are defined in the documents) include the use of gloves in every phase of the manipulation, the prevention of needle sticks injuries by the prohibition to recap needle sticks or to bend them, the prohibition of pipetting by mouth, the practice of washing hands after every manipulation and conclusively whether feasible, to find out if blood samples coming from patients have been controlled for HBsAg presence. Matter’s performativity, as it emerges from these considerations, exerts its power in the definition of researchers’ bodily acts, and by assessing certain features of the world that are internalized in daily practices. In fact, it is in this repetition of acts that performativity takes an iterative nature and power is expressed as “the condition of its own possibility” (Butler, 1990: XXV). This shift from defining materiality as an external and pre-constituted entity towards its internalisation is analysed in the next section, in which implications of materiality in definition of self are discussed as a second aspect of the performative and enrolment dimensions of innovation.

Constitution of an embodied self

As suggested above, matter’s dynamism according to Barad (2004) emerges at different levels: as a bridge or separation among researchers; as a materiality with the ability to respond to the actor’s manipulation; and as a performative object which constitutes researchers’ identity. In this last sense, matter and its relation to the actor can be seen as part of an enrolment process in which various roles are “allocated” (Callon, 1986) to the elements involved, specifically, the actor’s role as a researcher is formed. Following this, identity is “formed” and “adjusted” only during action (Callon, 1986), through what Michael Callon defines as a process of intersement, in which actants tend to stabilize other actants’ identity. This process of identity definition is relational, as the identity of one actant is constructed through its association to other actants. Viewing out empirical setting through this perspective, when Karen, head of a unit and employed in IPR for more than 15 years defines herself as a researcher, her identity is consolidated through its relation to that materiality which constitutes her daily practices as a researcher, as the following quote shows:

“I deal with experimental models of kidney diseases; I work with animals, hence diseases of animals, to then study mechanisms and effects of pharmaceutical products. My job has been this for many years now.” (Karen, head of unit in IPR)

In the above extract, Karen defines her work in terms of the object of her manipulation: matter. Not only matter acts in the enrolment process of an actor as a researcher, but it further

becomes the element of identity appropriation and self-definition based on what matter requires the actor to perform. Camille, a senior researcher in IPR, describes the role of matter in the definition of what being a researcher means, and the characteristics related to this role as follows:

“I don’t think everyone is able to do this job. Anyway you need to be a person always ready to challenges, because it can happen that the experiment as you thought it gives you an unexpected result. Hence, you need to be able to re-invent the experiment at the very moment; there is always a need of comparing. Every day you compare yourself with things you obtain; maybe you don’t get what you thought about. It is a comparison and a re-discussion of getting involved, always being dynamic, being very malleable: I thought it this way, but maybe it is better to do it another way. And then there is the operation on the counter, for which you need a certain precision, a certain orderliness, also in doing certain things, you need to be precise because you risk to contaminate. And you need to wait because it is not like you do the experiment and then you immediately see the result. There are experiments whose results you can see after a month if you are lucky. This job is like this. And you also need to be always up-to-date. You need to keep in mind you need to study every day, because research world goes so fast as now there are lots of new methods and I don’t think everyone is able to be so dynamic and to put themselves into question all the time”.

What we can see from the above is that being a biomedical researcher is not only about learning the ways around daily practices, but it is more about an appropriation process in which researchers come to “embody” (Shotter, 2011:12) the outcomes of their engagement with the material world.

Accordingly, as it emerges from the excerpt here, matter contains agency (Barad, 2003, 2007; Shotter, 2011); our material engagement with the world, our joint activities and intra-actions with other actants define our identity. The process of becoming a biomedical researcher is an entanglement of matter’s agencies: biomedical objects require actors to be constantly engaged in a learning process: a specific precision of handling matter as researcher’s misconduct could result in its contamination; a strong passion towards work; and a commitment to finding innovative outcomes, such as a cure to certain pathologies. From this, the nature of the relation between objects and actors is co-constitutive: matter defines behaviours the researcher needs to implement, and at the same time the researcher manipulates matter. In so doing, matter and human actors mutually concur in constituting their sociomaterial identity. In this way, the identity matter purports to sustain through its relation to the embodied self is one which is entangled to material and social practices, and human agency is just a part of this “constituent entanglement of materiality and sociality” (Shotter, 2011:2). Identification in this sense is an “enacted fantasy or incorporation” (Butler, 1990:185) of matter in the embodied self of the researcher which happens through a process of enrolment: the researchers’ bodies -

and identities- are performed through a process of association -and disassociation (Akrich and Pasveer, 2004)- of body and self, happening through the mediation of intra-acting components, which include matter of different types, such as cells, technological instruments, and personal protective equipment (PPE) among others.

This is illustrated in the following example of the ways PPEs perform the researcher's identity through the assertion of requirements for "a regulated process of repetition" of bodily acts (Butler, 1990: 198). It relates to part of the documentation associated with entering IPR, with any new entrant in the laboratories being obliged to read documents, such as the Safety Manual. The document integrates national legislative decrees into daily working practices in the labs and especially sets rules on routinized bodily doings. Here follows an extract from this document:

"When it is not possible to ensure adequate protection of workers using facilities or equipment for collective use, it should resort to the use of personal protective equipment (PPE). PPE are regulated by legislative decrees, 04/12/1992 n. 475 and legislative decree 02/01/1977 n.10, but it needs to be distinguished when the same device constitutes a uniform or a PPE. For example: the gown, in laboratory practice, is usually a uniform, hence it is not required to have the characteristics prescribed by the above mentioned decrees; nonetheless for many workers (for instance: manipulating carcinogens or toxic by ingestion or contact, or drugs, especially if anti-tumour or mutagens cytostatic), the gown is a device of individual protection for the worker."

More specifically, the document further clarifies three PPE categories, implying a self-evaluation of the researcher of the risks involved in their work practice and a consequent adoption of physical protections. Some important considerations on the nature of performativity of matter emerge in this passage.

As part of daily work practices in the innovation process, matter matters to researchers at different levels. It can be argued that the national legislative decrees mentioned in the passage can be considered a type of nonhuman materiality which nevertheless is produced by human agency -from the rising concern of protecting the human body, to the performative act of the decree constitution. This aspect recalls an entanglement between human and nonhuman agency, hardly separable, additionally found in work practices (discussed in the next section). Ultimately, nonhuman agency performs the human body as it defines human identity -a researcher wears a gown as a work practice, it creates a distinction among humans -a distinction between those researchers that use a gown as a uniform and those that use it as a PPE, and it confines the researcher into a bodily configuration -the white coat uniform- which is repeated over time. In this perspective, matter is performative due to its ability to repeat over time a set of norms (Butler, 1993): here the performative stance of the two legislative

decrees is played in the repetition and integration of the norms in everyday practices, and their effect on identity construction. In particular, another entanglement of matter emerges: the type of matter involved in the innovation process (carcinogens or toxic, anti-tumour or mutagens cytostatic) rearticulates the meanings -and uses- associated to other matter (the white coat). Hence, the entanglements at stake involve human and nonhuman materiality and the borders of intra-action among them are blurry: matter of various types is “mutually constituted” (Barad, 2007: 197) within the phenomenon.

Incorporating outer materiality: ethical and emotional issues of relationship with material objects

The previous sections presented the ways materiality is named and described empirically as a strategy to define matter’s borders, and hence to confer a form to it, to confine it. Nonetheless, it has also been argued that this shaping is a relational one; a part of a process of enrolment and performativity which takes place through an intra-agency of various forms of matter. Following these considerations, outer materiality cannot be assumed to be an external essence (i.e. external to other components involved in the innovation process). Conceiving innovation as a process implies a vision of matter not as a *fait accompli*; rather matter, in all its forms, human and nonhuman, is in perpetual motion and entangled to other types of matter. It is in this entanglement, in this inseparability of actions, that a phenomenon, such as innovation, takes its ontological form. The “ontological inseparability of objects” (Barad, 2007:128) appears also in the emotionality of the relation between human and nonhuman matter.

Below are presented some passages from interviews with IPR researchers on their daily work practices with animals. Jessica and Karen have been working in IPR for more than twenty years and their emotional relation to matter changes according to the type of matter involved. This emotionality is consistent over time, as Jessica and Karen point-out it has accompanied their work over the years of research in IPR.

“I never worked in vivo, even if I am not contrary to it, even if I supervise people who work in vivo. Because I know how to do a certain thing maybe not from a practical point of view... but from an emotional perspective, I cannot think about sacrificing an animal.” (Jessica, senior researcher in IPR).

“It is not easy. It is not easy to work with animals. Besides emotionality...then you work with mice and rats of which you do not have a good impression as of the dog and cat ... I could not do it. But the mouse and rat, you think about the one from the sewer.” (Karen, head of unit in IPR).

These passages firstly highlight an engagement, a degree of emotionality, between the researcher and objects, which is repeatedly done over time. Through the reiteration of stylized

bodily acts (Butler, 1990), this emotional engagement performs over again individuals' identity and their connection to materiality. The last excerpt brings in a performativity mostly associated to the articulation given by Butler (1988): the relation between matter and researcher exists only if performed. Furthermore, the performativity that emerges here is to be intended as one that defines a process which produces ontological effects (Butler, 2010): it is only in the performing of the relation between researchers and objects that we see the ontological effects of performativity, such as the construction of an identity of biomedical researcher, or the definition of emotionality as part of working practices. Hence, a process of embodiment of this network of relations between objects and actors emerges as constitutive of an embodied self, the researcher (Berg and Akrich, 2004). Indeed, being a biomedical researcher entails a set of relations with matter which constitute this embodied self in its emotionality. At the same time these relations are constitutive of matter as matter implies specific bodily acts in its handling and shaping, and a specific attention to it as something external to the human body, which consequently becomes internal in its manipulation.

Matter matters to Karen and Jessica in their research practices over time, as emotionality characterizes their relation to matter. In fact, both researchers experience the dynamism of matter, which contributes in shaping their identity as researchers and their daily practices of producing innovation by the enactment of defence mechanisms of detachment that emerge in Jessica's interview. Moreover, Karen finds it challenging working with animals; she differentiates among types of matter (animals) and the levels of emotional engagement associated to them. To work with rats or mice is emotionally dissimilar than working with dogs and cats, or as Jessica explains later in that interview, working with murine cells is less emotionally engaging than working with human cells:

“As when for example here and elsewhere, when you work not only in vivo but when I use cells...to think of the patient who has specific ... like thinking of a child from whom ... from an emotional point of view I could not do it. [...]It's different to work with murine cells, even if you never have to forget the patient as the ultimate target. The ethical issue or the management of samples are never to be forgotten, but there are moments such as last week in which it happens that you receive cells from organs donors, which are healthy, because we needed them. To think about what happened to the person, an accident, to me is distressing, I need to detach from it.”
(Jessica, senior researcher in IPR)

Processes of emotional engagement and detachment were found to happen at different stages of the researchers' involvement with materiality in the innovation process. William, a newly arrived intern in IPR, expresses his concerns on matter and its impact on his daily work

activities, such as the initial “orientational or relational difficulties” he experienced with matter (Shotter, 2011:10):

“There has been also the impact of working with animals which was something new for me. I have never worked with rats or mice before, hence at the beginning it was a bit so...but after the first week you get used to it quite easily. And I was surprised because girls working with mice...you know usually they are a bit fussy, in reality it is just a first period of adaptation, then...” (William, junior researcher in IPR).

It is by overcoming these initial difficulties that matter performs the researcher’s identity: from an initial stage of puzzlement deriving by the extraneousness of handling specific type of matter to being accustomed to certain matter and setting borders among their types.

Similarly, Karen narrates her difficulty in finding researchers willing to work with animals, as she affirms it is one of the most challenging jobs of a researcher: practices are highly routinized, working with animals requires a long learning period so to reach the ability to efficiently manipulate them, and experiments are conducted in specific IPR laboratories, located underground in a restricted access area in which detailed protocols on PPEs and norms of conduct need to be followed. The difficulties of this type of job, as Karen suggests, are the reasons of a high turnover in the unit, as she affirms, her laboratory is IPR’s “thorn in the flesh”.

The material presented seeks to surface how Jessica, Karen and William as researchers, various types of cells and animals involved in the procedures, the research ultimate target, the experiment requirements, and their relations can be seen as “agentially intra-acting components” (Barad, 2003) that constitute the innovation process studied. In this sense, agentially intra-acting components ontologically constitute a phenomenon in their inseparability; in other words, there would be no phenomena without these components constructed through intra-actions. Hence, innovation is constituted by agentially intra-acting components such as objects and, more generally, matter at stake and its implications on daily practices. It is in the entanglements of these components that issues arise on the flow of the making of innovation. An important question therefor arises: what are the consequences of the entanglement of intra-acting components in innovating?

Matter entanglements

This section aims to depict the different issues at stake when matter acts in the making of innovation: artifacts can become critical elements in the relationship among researchers, causing delays, lack of cooperation and boundaries between research units. At the same time matter acts at the ethical and emotional levels, by performing the researcher’s body and self-

embodiment process, but furthermore matter of various types are entangled so to enrol each other in a process of identity constitution. As emerged in the previous section, a separation among matters of all kinds is hardly achievable, and this will be further discussed in the next paragraphs by bringing in examples of the entanglement between human and nonhuman bodies. On a further level, the relationship between the researcher and the spatial configuration of the laboratories and the technologies in use will be highlighted not only in their influences on daily work practices, but also as the node of entanglement of different researchers.

Matter's performativity on body and self-embodiment

Akrich and Pasveer (2004) elaborate a version of performativity which focuses on bodies and self, performed through “elements”. In IPR these elements comprise technical instruments, laboratory spaces, biological materials (cells, animals, liquids, etc.). As the authors highlight, the ways people demarcate their identities and bodies is a result of the entanglement of these entities, and the “process of materialization” (Butler, 2004:9) of the researchers’ identities is reiterated over time and its effects are stabilized into matter. It is in this sense that the researcher’s identity is a type of matter which contains boundaries that are fixed over time according to the changing conditions of the relation among “elements”. A clarification of this aspect can be found in those situations in which the body of the researcher, its physicality, changes, therefore challenging the present conditions of actions (work practices). Particularly, this is evident when the woman’s body is pregnant and this pregnant body limits her scope of actions in the laboratories. As Deborah, researcher in IPR, highlights, her recent pregnancy has changed the type of work she is allowed to perform:

“So far I have been working on genetic therapies, taking a model of a mouse which was miming a human disease and substituting an affected gene with a healthy one. Now I am changing a bit, I am writing a new project hence I am doing more of a desk job, also because I am pregnant, therefore I cannot do much work. [...] This (being pregnant) is one of the major problems. [...] No, I cannot do anything. Legally I could not enter in the laboratory.” (Debora, researcher in IPR)

These changing conditions affect both the enacted practices but also redefine the researcher’s identity. This experience is shared by several researchers in IPR, as Laura (a senior researcher) recalls her experience of being a mother as limiting the possibilities of working with specific matter (such as radioactive substances) during the breast feeding period of her child or as her choice to interrupt breast feeding so to be able to work with radioactivity. In her narration of the experience of becoming a mother, Laura defines the condition of being pregnant as a “physical impediment” in her daily work. The formulation of the pregnant body

as a “problem” is shared by Laura and Deborah, and by other researchers in IPR. Deborah is in some way experiencing the pregnant body as a problem, as an issue which interrupts her work and limits her career perspectives.

Hence, the elements of the process of materialization are various: from the researcher’s body to the spatial allocation (laboratories), from animals to material substances (radioactive waves, cells, and more). This entanglement emerges at the level of identity constitution, but furthermore in the constitution of the elements fundamental in the innovation process. As William explains, matter can impact the outcome of the experiments in the making of innovation:

“Sometimes postponing a decision, especially with animals, can bust all the results or compromise the animal. If you wait two or three days the animal dies or else.”

From this, it can be assumed that matter not only constitutes the researcher’s identity but in an intertwined way the researcher constitutes matter. As Barad (2011) observes, this intra-activity of matter is not an interaction between two entities; rather for Barad it is a “mutual constitution of entangled agencies” (Barad, 2011:451). This is a key point in the understanding of innovation in processual terms: innovation as a phenomenon emerges through the intra-actions of several agencies (the researcher’s body, the substances involved in experiments, the research practices and techniques, the technological instruments, among others) that are sociomaterial in the sense that no separation between the social and the material can be assumed. Highlighting the entanglement of elements as it has been done in these paragraphs is a way to sustain a conception of phenomena formed by components whose boundaries are defined by ontic and semantic “agential cuts”:

“It is only through specific agential intra-actions that the boundaries and properties of “components” of phenomena become determinate and that particular articulations become meaningful.” (Barad, 2007:148)

In this perspective, a phenomenon such as innovation is ontologically inseparable, but composed by distinguished entities which form the phenomenon in their intra-actions.

Materiality at the centre of relationships and its impact on innovation process

Not only matter becomes central in the innovation process as playing a role in researchers’ daily practices, and hence performing their identity as biomedical researchers. Its dynamism is found in the different ways matter, such as laboratory spaces and instrumentation, intra-act in the evolving of researchers’ relationships among each other. The arena of manoeuvre of interactions between researchers, their relations or entanglement, is mediated and negotiated by the manifestation of matter. It is in this sense that matter becomes a “stabilizing and

destabilizing process of iterative intra-activity” (Barad, 2007:210). This process emerges in IPR through the ways matter acts in the definition of researchers’ relationships. Particularly, matter can critically configure the relationship between researchers and their effects emerge in innovation making as diffusely evoked by IPR researchers. In this sense, the type of matter in question is identified not only in technologies or work space, but especially practices, ideas, and knowledge. Matter hence can hinder the fluidity of innovation, by becoming the contentious of researchers’ communication and knowledge sharing, as Gabby (researcher in IPR) states:

“Something lacking here in my opinion is link among groups and people. Because sometimes you work on similar issues but everyone looks at their small piece and there is no exchange of information.” (Gabby, researcher in IPR)

Several researchers in IPR identified as a key issue in the Institute a myopia in the understanding of the importance of sharing capabilities and “domain specific knowledge” (Carlile, 2004). IPR researchers commonly refer to this phenomenon as keeping their own “snippet” separate from the one of other researchers and cultivating it as an individual domain specific knowledge. A consequence of this is the loss of a broader picture of the innovation process. It is in this sense that knowledge becomes not only a critical element in researchers’ communication, but specifically it can harm the innovation process by inhibiting the understanding of its wholeness and by underestimating the beneficial effects of sharing ideas and knowledge, as Natalie suggests:

“On regards of certain groups if you don’t share a project with them you don’t even know what they are doing. You are aware of the projects you have in common, but for the others you don’t know anything. [...] and it is not about knowing what they are doing. It is about understanding if they encounter the same problems as you, that might be similar to yours and maybe together you can solve them more rapidly, to think over certain aspects by yourselves is harder. Maybe they have more competencies than you in doing that, but even simply sitting down and discussing is fundamental in this type of work. Especially if you behave a bit as an external, because you can see things in a different perspective from who is in. Maybe after a long time you are fossilized on specific experiments, you need to finalize a work, but you cannot do it because you have a vision which is not limited but conditioned. An external person sees it for the first time and gives you advices that are totally different than what you could have taken up.” (Natalie, senior researcher in IPR)

Rafaela, head of unit in IPR, also suggests the importance of having someone who plays the devil’s advocate role, so to frame the potential incongruences of the project design. Sharing knowledge and information has beneficial effects on the practices of innovation itself, but also on adopting technology for innovation purposes. This has been the case in IPR for the acquisition of a hood for weighting powders. Originally hazardous chemotherapy drugs were

weighted in an open environment, using masks in an aired room. Similarly, this was the case for chemical hoods where western are developed. The discussion among researchers on the necessity of further protection has roused a shared interest in adopting new technologies for work practices. To summarize, domain specific knowledge, practices and ideas can be considered barriers to innovation (Carlile, 2002) instead of representing a common ground for coordination which is vital in innovative contexts (Carlile, 2004).

On regards of matter such as instruments or laboratory spaces, their entanglement with researchers is to be found in the ways they convey certain ways of structuring their relationships. Specifically, when technologies need to be utilized by different researchers, they can obstruct a fluid relationship among them, aspect emerging for example in Brian's description of current issues with organizing mice in the laboratory:

"We had two ventilated carts for mice, one cart disappeared because: "well, anyway you don't need it". Now we ordered mice and they don't fit anymore. We don't know if we have enough carts. We need to work, we cannot go around to ask ten people to do one thing. To me it seems, I don't know if it is like this in the other labs, that the others have an easier access way. For us, every time we need to three or four confirmations before getting it. Maybe because I am stubborn I don't stop to the first response. [...] because if I need ten carts, ten carts need to come out of somewhere, I don't understand why the others can have them and not me. [...] and this is bad, because if there were a little more collaboration..." (Brian, researcher in IPR).

To avoid this lack of coordination, technical instruments such as the fluorescence microscope need to be booked over a calendar present in the microscope's room. Hence, turns are taken by researchers on a first come first served basis. Again, coordination of actions is crucial in carrying out innovative practices, as Gabby notes:

"I think that for working here you need to have a certain degree of precision, a certain order, a certain way of relating with the others also because many instruments are in common, you need to book, hence an availability in a way because if my experiment has been skipped I come to you to tell you: listen, I don't need the machine anymore." (Gabby, researcher in IPR)

Structuring conditions: adopting and implementing exiting regimes as a way to capture the broader structure

One of the main critiques to Barad's version of sociomateriality is a disregard of a wider structure in which sociomateriality is to be found (Mutch, 2013). Her perspective on performativity and intra-activity seems to be localized, constrained to micro dynamics and actions. This implies a neglect of the broader context in which performativity takes place. Specifically, according to Mutch (2013), Barad's perspective does not help taking into account in the analysis of a phenomenon those factors, such as power, which contribute in

outlining the components' intra-actions. To address this issue, this section provides an account of the external forces that intra-act in the definition of the innovation phenomenon, as it is here believed that these factors stand as material (human/nonhuman) components which constitute innovation in its entirety. In other words, an account of the innovation process cannot distinguish between the intra-actions occurring at different levels of the phenomenon. As mentioned in previous sections, researchers, objects and procedures, the research ultimate target, the experiment requirements, norms of practices (such as legislative decrees and organizational regulations on procedures), broader technological changes, and so forth, are all part of the constitution of innovation in processual terms.

Specifically, structuring conditions of the innovation process have been identified in the case of IPR in the creation of the innovative environment, in the implementation of tacit rules and in those structural conditions, such as technological changes and economic issues of being a non-profit organization.

Creating an innovative environment: the performativity of norms and hierarchies in the innovation process

One of the central aspects of the innovation process is the conditions of its happening. In this sense, the rise of innovative ideas, its conditions for success, the existence of enablers for innovation and, on the contrary, of obstructing conditions (some of which have been identified in the previous section) are circumstances which can foster or hinder the development of an innovative context.

Creating an innovative environment entails firstly a degree of freedom in daily practices of researchers. As many researchers in IPR argued, flexibility in IPR to experiment and follow different paths allows them to find solutions to existing issues in the innovation process. One example is offered by Penelope, a senior IPR researcher:

“Lately I had experiments that were not working. I was following protocols that I didn’t understand...I couldn’t understand why experiments were failing. At one point reading the literature I tried to get more information, I started thinking that it was the solutions with which I was preparing tissues that were wrong. I tried looking into the literature; I saw some other works using other methods, other substances. Then I made some summaries of this and went to my boss: “Listen, we see that these experiments are not working, it has been a month now that I have been working on them. I thought, I read, and I found these researchers that use this method and I want to try to use it here.” Then my boss rightly said: “Do we have enough material to try it and have some material left so we don’t run out of it?” I told her yes and she gave me the go. She has lots of trust in me; maybe because I have been working here since 1997, hence I think she trusts me. Then the experiments came out fine.”

As Penelope briefly mentions, ideas can rise from a particular reading in the literature, or

from attending conferences and understanding new developments in the field, but especially by sharing queries and issues among researchers. As suggested in the previous section on the role of materiality in researchers' relationships, sharing ideas is highly beneficial for the development of an innovation. The conditions for creating an innovative environment then are found in the above mentioned degree of freedom to experiment, to discuss ideas with colleagues or managers. On the other side, ideas can result in a failure of a project, and the reasons behind this are various. As IPR researchers suggest, sometimes the starting hypothesis is erroneous; and it is only by running experiments that opposite results are found. In that case the decision becomes one of either following the unexpected path or to abandon the initial idea. In some other cases, within IPR it cannot be found a researcher disposed to help or having the technological instrumentations for its development. It is in this sense that technological devices (matter) can become obstacles in the making of innovation.

Secondly, other conditions for the implementation of innovation have been found in IPR: the existence of norms, either tacit or explicit, and a hierarchical configuration both have an impact on research daily practices. Specifically, some rules of behaviour as key factors enabling innovation within the company have been acknowledged by IPR members. These rules refer to ethical behaviour towards colleagues as to enable an effective communication but also an open environment for the circulation of ideas and research practices. Hence, a strong degree of honesty is essential in daily work both towards managers and colleagues, as Sandra reveals:

“Of course you need to say things immediately when they happen, because in this way the relationship is one of trust. If I make mistakes, and in order to hide them I don't say anything, it is not good and not even professional. [...] Honesty, loyalty, transparency in everything, from the idea I generate to the mistake I could have made.”

Honesty and transparency on research practices and ideas are aspects incorporated by researchers as “good” and “professional” behaviour. In this sense, the assimilation of tacit norms such as the one of transparency can be seen as the outcome of performing an “agential cut” (Barad, 2003) of matter (matter is in this case norms intended as an external materiality), for which norms generate a separation between the positively appraised research practice and the negative one. At the same time, this incorporation becomes part of the construction of an embodied self, defined as a good and professional researcher, involves the performing of such norms. Furthermore, a strong passion towards biomedical research and specifically towards their daily job is a key element IPR researchers identified as being both a norm and a facet of their identity as researchers in IPR. This passion not only drives their daily work, but involves

them in accepting long working hours (or working from home) and low wages as a good compromise for working in the field of not for profit biomedical research. As a conclusive aspect, one of the norms of being an innovative researcher is a process of continuous learning. This aspect is identified as a norm, a rule in the creation of an innovative environment as its acceptance by researchers is part of their identity making and performing; the researchers' identity is produced and altered in the reproduction of norms (Butler, 2004). Hence, when Gabby mentions her process of entering the Institute, this norm emerges as key requisite, stressed by the top management, for working in such environment:

“When I arrived here, Emily (Head of Department) told me: this is not the work of the mail. And it is true. You don't come here to do the piping, a thousand tubes, this is a job that in a year you can get out a thousand publications on what you are studying, then you have to study, update, learn new techniques as well as to study and in all this assimilate and build, not only to passively receive information. So in the building, in the assimilation of what you're doing, you also propose. To me this is what has to be a researcher, and I think that's what they expect, by “they” I mean the leaders; they expect this from the majority of people.”

The creation of an innovative environment is not merely confined to the reiteration of norms (it is not simply “citationality”, Butler, 1993); rather regulatory practices have a material dimension, which alongside with material constraints and exclusions are key aspects of the process of materialization (Barad, 2003). Furthermore, the creation of an innovative environment is extended to the ways in which the organizational structure shapes the environment and hinders or enables innovation making. One of the key aspects identified in IPR as critical in the making of innovation is the compartmentalization of the organization. IPR has a clearly defined organizational structure in which hierarchies correspond to specific roles. Nonetheless, as Jonathan highlights in the passage below, to the escalation in the hierarchical pyramid does not correspond an increase of power in decision making. Decisions on instrumentation to buy and resources to acquire are taken by heads of departments; whereas research directions can be taken by heads of laboratories². For IPR researchers, the possibility to allocate decision making strategies not only at the managerial level, but also at lower levels is seen as beneficial for the innovation process. Decentralization of decision making is seen as the necessary step towards an improvement of knowledge sharing, a reduction of time for the formulation of a decision (seen as a competitive advantage) and an empowerment of researchers at all levels which can be a strong immaterial motivational factor towards work, as described here:

² To simplify, the structure of IPR departments sees head of department, head of laboratory, head of unit and staff members in a descending pyramid.

“If I become head of unit and I can allow myself some things, well here it does not work this way. You become head of unit and this is it. You can write below your email that you are head of unit, but there is not...of course there is an increase of salary, but it ends there. You cannot go to the head of department and say: “This is my unit, I decide, I call, I do this technical intervention, I buy this microscope.” No, because for that microscope you need to first circulate the idea, then to discuss it with the head of the lab, then with the department director, who refers it to the Professor, then the Professor comes back to you saying it is too expensive, etc...”.
(Jonathan)

This hierarchical structure is not only emerging in the process of decision making, but also at the level of circulation of ideas. Some researchers in IPR stress the impossibility of a flawless communication among laboratories, as they tend to be compartmentalized. Specifically, each laboratory tends to perceive their work and practices as their “territory”, not easily accessible by others. Some researchers in IPR expressed the discomfort in referring or asking for advices to colleagues in other departments as there are invisible borders that need to be overcome, such as the necessity to firstly address the head of the other laboratory before taking time from the colleague.

Identity performativity: being a non-profit organization in the Italian context

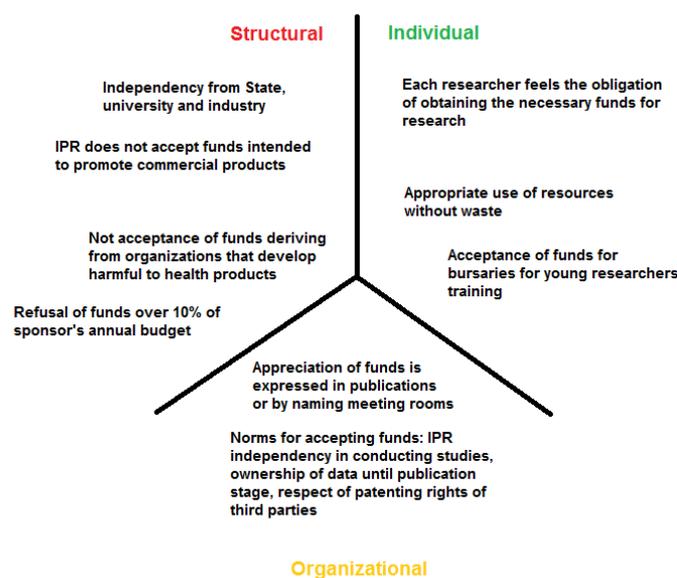
This section aims to address the potential critique to adopting Barad’s and Akrich’s perspectives in the analysis of the innovation process which is found in the lack of consideration of a broader structure (Mutch, 2013). One of the main issues IPR faces in its innovation practices derives from its structural condition of being a private non-profit organization. In its statute, IPR defines itself as a “moral entity”, with not for profit objectives, publicly and privately funded.

Not for profits are regulated in the Italian legislation by the following laws:

- Civil Code, art. 11-42 (Disciplines associations, foundations, and committees)
- Law no. 266 of 1991 (Regulates voluntary associations. Specifically art. 5, par. 1 defines the economic resources for such associations)
- Law no. 381 of 1991 (Disciplines cooperative societies, implemented by regional laws instituting a register of social cooperatives)
- Legislative Decree n. 460 of 1997 (Tax regulations for non-commercial and non-profit organizations)
- Law no. 383 of 2000 (Disciplines associations of social promotion (APS))
- Law no. 328 of 2000 (Framework Law for the implementation of the integrated system of interventions and social services -implemented by Regional Laws)
- Presidential Decree no. 361 of 2000 (Simplification of the administrative procedure)

for the recognition of private legal persons)

One of the performative dimensions of the innovation process can be found in the definition of IPR as not for profit, its related legislation and independency from State and industry. This gives IPR freedom from political pressures, but at the same time enacts economic ones. Economic resources are acquired autonomously by members of IPR, as IPR's "Charter of values and code of ethics" states under the section "Values". The performative dimensions of innovation emerge, at the level of identification as a not for profit, in the interconnection between structural, organizational and individual conditions which are not separate.



The figure summarises some key aspects contained in the charter which refer to the levels of individual, organization and structure. Nonetheless, no clear demarcation among these three dimensions is viable. Structural, organizational and individual elements are not "imbricated" (Leonardi, 2012) in the definition of IPR identity as not-profit organization; rather, following Barad's (2003) stand, certain conditions enable specific actions: the limitations IPR, as a non-profit organization, has on the ways research is funded is strictly linked to the conditions of acceptance of funding and consequently to the individuals' efforts to gain and allocate resources. In this perspective, the concept of enrolment helps to understand how the three dimensions intra-act in a performative and entangled way. For instance, the structural condition of being a private not for profit is enrolled into the organizational dimension in the definition of what funds can be accepted and which ethical standards IPR is ought to follow. Furthermore, this organizational framework, synthesized in the ethical stand of IPR towards funding acceptance, is enrolled into the individual level whether this stand unfolds in

researchers, at different levels, being strongly encouraged to seek external funding, or the training possibilities for young researchers being subjected to the availability of bursaries.

These aspects are part of and affect the innovation process in three ways. First, being a not for profit implies a set of measurement of productivity which is different from for profit organizations:

“Something I need to learn is to understand the context here, because also at university you still do research, but it is different. Whereas university depends on funding which exist, here it is a mixture between a firm and university because it is a non-profit, it is a foundation, there are no logics of products, but still you need to have a sort of productivity. Even here if you think about it, I heard people saying: this year I haven’t published anything, last year I have not published, maybe they will fire me. At the end this is not true, I am just reporting what I heard, but obviously this is something that is here. It is true that you are not a sales person, but it also true that they judge you based on your productivity, hence there is not much difference.” (Sandra).

Secondly, limited resources constrain the process of innovation as ideas are evaluated also on the total expenditure for their development. In this sense, researchers have to consider the economic affordability of an experiment or an idea before implementing it. Conclusively, not only financial constraints directly affect the possibilities of engaging in experiments, in defining research directions, in the researchers’ engagement with fundraising issues, they furthermore affect the individuals operating in this context due to the low wages and lack of job security at lower levels of the hierarchical structure, which are seen by IPR researchers as the reasons of high turnover and loss of knowledge. In this sense, the choice of being a non-profit affects the innovation process by producing a lack of material motivations towards work, high turnover and knowledge leaks (Brown and Duguid, 2001).

Discussion

The paper set out to elaborate an account on matter dynamism (Barad, 2007) in the making of innovation. Taking this perspective entails the consideration of mattering involved in this making, the entities taking part of the process and the flux of their relations. In this paper three mattering processes in which different components are involved have been identified. This mattering emerges in the making of innovation as the loci of agency, hence as the arena in which enrolment (Akrich, 1992) and performativity (Barad, 1996, 2003) take place.

The first aspect of enrolment and performativity identified is matter constitution, which comprises three processes: naming or describing materiality, whether human or non-human; the incorporation (Butler, 1990) of matter in the embodied self of the researcher which

happens through enrolment and association/disassociation (Akrich and Pasveer, 2004) of body and self and through ethical and emotional relationships with between matter.

A second aspect is matter entanglement: matter performs on the body and self-embodiment, and also through its centrality in the relationship among researchers. In this acceptance, interactions between researchers, their relations or entanglement, is mediated and negotiated by the manifestation of matter.

The last aspect of mattering discussed referred to what are here called “structuring conditions” such as the process of creating an innovative environment and its connection with a broader framework, such as the implications of being a non-profit in the Italian context for IPR for the innovation process.

These three aspects of mattering are not separated from each other: the ways materiality is defined by actors, either as materiality perceived as external from the individual or one which is identifiable as an “embodied self” (Akrich and Pasveer, 2004), are not separated from their doings, their daily work practices or the conditions that frame these processes -tacit or explicit norms at the organizational and institutional level. All these elements, it has been argued, constitute as a whole the performative and enrolment aspects of the innovation process.

What the above shows is that when taking into account the way a post-humanist performativity directs attention to practices, doings, or actions in the analysis of the phenomenon, it is also crucial to recognize both human and non-human in “everyday social practice, scientific practices, and practices that do not include humans” (Barad, 2007: 32). While the link between materiality and performativity is also evident in Butler’s formulation of performativity as a “reiterative and citational practice by which discourse produces the effects it names” (Butler, 2004:2), for Butler the materiality of the body is the effect of the power of discourse. Part of the analysis offered in the paper highlighted such acceptance of materiality as profoundly relying on the power of discourse and agency as not a single action but as a repetition of actions which “conceals or dissimulates” (Butler, 2004:12) the norms/ and regulations it repeats. The paper also shows, however, the difficulty of an ontological separation between material and social before the happening of the entanglement: the levels in which these entanglements happen, as has been seen, are intricate and inseparable from each other.

Using a performativity lens such as the one we attempt to articulate in this paper to understand innovation in processual terms shifts the attention of the researcher from the

identification of phases (Van de Ven et al., 2008), the temporal sequences of activities (Van de Ven and Rogers, 1988), and the components of the innovation journey (Slappendel, 1996), to the identification of issues related to the mattering involved in the innovation. That means a shift of emphasis away from the problems of managing human attention (Van de Ven, 1986), from transforming ideas into good currency, and from concerns about losing focus on the entirety of the process or the problem of strategic leadership and at the same time they do not imply the elaboration of “a program” on its management. Instead, the perspective implied here draws attention to the elements constituting innovation and the importance of opening-up reflections on the difficulties, contestations, and settlement encountered in the unfolding of the innovation process. Specifically, such a way of looking at innovation can inform and make conscious the researcher of its potentially unsettling aspects and how they relate to the processual nature of innovation. As the paper shows, this can be in the strong relation between researchers and matter of various types, the ways matter is named by researchers but also incorporated in them as an element for identity definition and appropriation and for a separation of the Self from the Other.

Furthermore, the research also shows how the different ways researchers define their objects of study and the emotionality that characterizes their relation influence the process specifically in the ways researchers discern among practices that are available and implementable in the innovation process. In this sense, the emotional attachment to the object, the physical ability to work with some types of matter (the impediment of the pregnant body or of an allergy) can cause limitations to a free operationalization of routines and can affect the ability to operate with matter.

Another finding that is striking relates to how objects intervene in researchers' relations in different ways and how these can cause a lack of cooperation and knowledge sharing which hinders the output of the innovation process (e.g. the optimization of timing for delivering new insights on drugs or laboratory discoveries monitored through publications).

Ultimately, it can be argued that conditions which are in appearance located externally to the innovation happening in the laboratories are instead *de facto* integral parts of such a process and influence its outcomes. In fact, outcomes in a process perspective are just “ephemeral way stations in the ongoing flow of activity” (Langley et al, 2013:10). In the empirical material presented here these elements can be identified strongly in the constant fears of researchers of not finding funding for their research projects, of job loss due to the unstable conditions of not for profit research in the Italian context, and in anxieties around low wages

and job discontinuity. All these elements are identified as hindering the smooth flow of innovation, especially in the operability of daily routines.

On a more general theoretical level, the perspective we pursue to articulate from this research seeks to make a contribution by enriching current frames and perspectives on the processual nature of innovation by: a) claiming the inexistence of a separation between structure/action; and b) highlighting the importance as a locus of attention for both researchers and practitioners, of the entanglements through which matter of different kinds is performed in the making of innovation. Both these contributions provide fruitful avenues for further research, especially in terms of informing further studies on different processes of innovation happening in different locales and sectors.

Concluding remarks: can agential realism and social studies of science and technology/ANT approaches coexist?

Taking into account Barad's and Akrič's theoretical perspectives has resulted in an entangled elaboration of sociomateriality for which, at times, contours between the two are not clearly delineated. This section provides some concluding remarks on the linkages and differences between the two theoretical stances and provides insights on how these have played-out throughout this paper.

To summarize, Barad's ontology is an agential and posthumanist one: no separation exists between the material and social, culture and nature, observer and observed, as every type of matter is entangled and inseparable. Furthermore, she rejects both a social constructivist and traditional forms of realism as the former sees science as a mirror of culture and the latter science as a mirror of nature. For Barad there is not such a distinction among science, nature and culture, there is no autonomous world out there, hence no distinction between materiality and social construction. On the other hand she also refuses a poststructuralist view of reality: there is no outsider attributing meanings to reality. Hence, for Barad there is no outside reality, only one wholeness. This is not to say that phenomena are just one whole, but that this entirety is one that incorporates entangled elements. Barad's agential realism surpasses a positivist/empiricist programme as the observation process needs to be taken into account. Hence, the measurement process is not outside the phenomenon but constitutive of it. In this perspective, agential reality is our participation within nature and so reality is not made by fixed elements, but by the actions of its forming, by the entanglements of agency of all kinds that constitute the phenomena.

Respectively, Akrich's reality is formulated as the entanglement of entities which have a role; reality is made by the ways actors in-script roles into objects and the ways others de-script them. A phenomenon is composed by a variety of elements (human and non human) which constitute it. Hence, ANT/SSST's reality has a relational ontology: material and social are "mutually and emergently productive of one another" (Pickering, 1993:567, cit. in Orlikowski and Scott, 2008: 459). For these theorists entities are not discrete and are not faits accomplis; rather, they

"acquire form, attributes, and capabilities through their interpenetration. This is a relational ontology that presumes the social and the material are inherently inseparable. As Barad (2003, p. 816) argues, this is a constitutive entanglement that does not presume independent or even interdependent entities with distinct and inherent characteristics. The portmanteau "sociomaterial" (no hyphen) attempts to signal this ontological fusion. Any distinction of humans and technologies is analytical only, and done with the recognition that these entities necessarily entail each other in practice" (Orlikowski and Scott, 2008: 455-456).

Furthermore, also the distinction between observer and observed is eliminated in ANT's perspective; as MacKenzie et al (2007) highlight economics makes markets in the sense that there is no outer reality (the market) which is described by economics, but economics does affect the market while explaining it. This is all consistent with Barad's ontological stand. Barad (2007) brings in the example of the Schrödinger's cat paradox experiment to pinpoint the above mentioned claims of her agential realist ontology: non separation between observed and observer, importance of apparatuses in making agential cuts, entanglement of different elements (human and non human). Similarly, Akrich and Paasver (1994) use the practice of childbirth to highlight the "conditions of possibility of crucial social practices of meaning making" (Barad, 2011:450). The two perspectives are hence reconcilable in their relational and agential ontology, for which elements constitutive of reality intra-act, and do not inter-act (no dialogical, two-way, production of reality), as extensively discussed by Akrich and Paasver (1994), Akrich (1992) and Barad (2003, 2007, 2011).

However, a significant point of dissonance between the two is found in the politics associated to the relationship with reality. Barad (2011:450-451) takes the political stance quite seriously; as a feminist she is interested in how science can be done more justly. This is not the case for Akrich (1992), for which even in the cases where the political is emergent - as in the example of the electrification of the Ivory Coast (Akrich, 1992: 214) - this is dependent on the role of actants in the network: the political is contingent to the enrolment process. In this sense a strong difference is found here: Barad (2011) is strongly concerned with questions of how this entanglement can actually make our reality a better one, whereas Akrich downplays

the autonomy of elements to perform such action: the political for Akrich is in the objects and their inscriptions and the distribution of roles. In this sense, the political dimension is found in the power certain roles detain, which is connected to a prior event: the process of inscription of roles into objects. It is in this inscription that power dyscrasia is found (who and how inscribe roles into objects) and, only consequently, in the outcome of such inscription: the role itself. Differently, for Barad questions of power are found in the entanglement and the agential cuts that accompany it. For Barad, agentially cutting a phenomena means taking a position from which reality is observed. This agential reality hence takes a particular form according to where the cut is defined: “different agential cuts produce different phenomena” (Barad, 2007:175). This implies that meanings attributed to elements of phenomena emerge only through the ways the apparatuses cut the phenomenon. In other words, power is found for Barad in the ways apparatuses (“macroscopic material arrangements” Barad, 2007:142, active instruments of observation and measurement, in Bohr’s terms) define concepts and especially which concepts are excluded from the formulation of the phenomena. Following this, for Barad the political dimension is inherent in all aspects of reality, as she believes practices are connected to certain “axes of power” (Barad, 1996:162). Differently for Akrich, the questioning of the power of actants is linked to their roles in the intra-activities, and her theoretical stand lacks considerations on the potential alternative ways of such construction, on how roles can be negotiated or performed differently – maybe in a more just way.

This fundamental discrepancy in the two perspectives also reflects in a different way of connecting micro and macro. The connection with the macro context for Akrich is related to the enfolding of the complex structure of the forces that represent our reality (as she clearly exemplifies in Akrich, 1992: 205 with the car example) and the set of political forces driving such a representation. Similarly for Barad, attention is dedicated to all elements (social-material) that constitute the phenomenon at different levels. Nonetheless, Barad makes further considerations by questioning what matter is excluded and how. Instead, for Akrich roles are *a priori* set-out if not precisely defined, before the unfolding of the phenomenon. This can be seen as a naturalization of the political inscribed in objects and the formation of the status quo through such stabilization.

Despite of these dissimilarities, the two approaches have revealed in this paper that if taken in broad terms they can be complementary and useful in the understanding of innovation. Differences were back grounded because the paper did not set out to address specifically the politics of objects and their entanglements, for which then some further considerations on the

two different perspectives would have been necessary. More importantly, in the paper it was seen as more valuable to highlight how the two perspectives offer a focus on action which, while it stems from two different angles, was also integrative: action for Akrich is found in the process of inscribing roles in materiality of different kinds, whereas for Barad action is inherent to matter, as matter –human and nonhuman- is always performative. What both perspectives have in common is to identify agency in matter, and this has been found to be consistent throughout the research presented in the paper: objects create a feeling of attachment and engagement for the subject and can become the object of quarrels and contestation among them. At the same time, researchers exercise action on objects in their reshaping through manipulation.

In terms of the wider debates around sociomateriality we set out to engage with (Leonardi, 2013, Mutch, 2013, Orlikowski and Scott, 2008 and 2013) and calls for an increase of works which empirically investigate organizational phenomena through the use of such a perspective, as outlined above, this paper addresses Leonardi's (2013) and Mutch's (2013:31) critiques to an agential realist perspective centered around how a detailed account of materiality hinders the elaboration of connections with a broader structure. Our approach suggests that by engaging with both Barad's and Akrich's theoretical stands, links with macro elements are taken into consideration and in a way so that cultural/political aspects are not depicted as not separable from material ones, with ontological priority not given to either. It is not only in relation to theory and the debates around sociomaterial perspectives of innovation and technology that this is relevant. For those engaged in processes of innovation, a view of the world through a sociomateriality lens means taking into account the different aspects while looking at such phenomenon in its processuality: attention hence shifts from the temporal dimension of evolvement over time, to the one found on citationality and performativity of intra-actions of the sociomaterial in the making of innovation.

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