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UNDERSTANDING PROXIMITIES: THE CONTRIBUTION OF THE DESIGN-CENTRED APPROACH TO INNOVATION

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Abstract.
The spatial character of innovative activities was initially explained with reference to externalities that prompt activities to group together. Although the spatial character of innovative activities can be observed empirically (Madiès and Prager, 2008), it is no longer analysed uniquely in terms of physical proximity. By examining the modalities governing the externalities diffusion, a growing number of researches have shown that geographical proximity is only profitable when it is associated with other types of proximity: relational, organised, institutional or cognitive (RERU, 1993; Pecqueur and Zimmerman, 2004; Boschma, 2005).

Although most researchers accept that there are several types of proximity, questions remain about the relations between them and about the modalities of these relations. The present research used the design process, which is the central process of the innovation process (Kline and Rosenberg, 1986), to study the relations between the different types of proximity involved in all innovative processes.

Data on the actors involved in the various stages of the design process were compiled via a quantitative survey of 800 firms in the Rhône-Alpes Region of France. As well as highlighting differences in the types of actors involved in the successive stages of the design process, our study allowed us to examine how the different types of proximity coexist and interrelate within the design process.

In addition to confirming the validity of the proposition that "geographical proximity will be mobilised in different ways and to different extents according to the stages in the collaboration process" (Rallet and Torre, 2006), our approach is interesting for two other reasons. First, it shows that Rallet and Torre's proposition is also valid for other types of proximity. Second, it allows the mobilisation modalities of several different types of proximity to be investigated simultaneously, thereby breaking with existing dynamic approaches, which usually only consider the mobilisation of one form of proximity.

Key Words: Design, innovation, proximities, spatial scale of actions.

JEL Codes: O18, 031, 032, R12.

Résumé. Comprendre les proximités : La contribution de l'approche de design à l'innovation
La spatialisation des activités innovantes a initialement été justifiée par l'existence des externalités attachées à l'agglomération des activités. Si le caractère spatialisé des activités innovantes semble une réalité empiriquement observable (Madiès et Prager, 2008), l'analyse s'est depuis affranchie d'une lecture standard de l'espace. Intégrant les modalités

de diffusion des externalités, les travaux de recherche en sont venus à souligner que la proximité géographique n'est profitable qu'associée à d'autres formes de proximité : relationnelle, organisationnelle, institutionnelle ou cognitive (RERU, 1993; Pecqueur and Zimmerman, 2004; Boschma, 2005).

Si l'existence d'une pluralité de proximité semble être largement admise, reste ouverte la question de comprendre comment ces différentes formes de proximité s'articulent et selon quelles modalités. La présente communication propose de s'intéresser au processus de conception en tant qu'espace de structuration de l'innovation pour comprendre l'enchevêtrement des différentes formes de proximité impliquées dans tout processus dynamique et innovant.

Nous montrerons, partant des résultats d'une étude quantitative menée auprès de 800 entreprises de la région Rhône-Alpes, qu'en considérant l'innovation à partir de son processus central, à savoir le processus de conception, il est certes possible de mettre en avant une mobilisation des acteurs externes différenciée selon l'étape du processus de conception considérée mais aussi de voir comment les différentes formes de proximité coexistent et s'articulent au sein du processus de conception.

Ce résultat mérite d'être considéré à sa juste valeur car d'une part s'il confirme la thèse selon laquelle « la proximité géographique va être mobilisée selon des manières et des hauteurs différentes en fonction des étapes du processus de collaboration » (Rallet et Torre, 2006) il révèle que cette thèse est valable pour les différentes formes de proximité, d'autre part il permet de considérer la mobilisation différenciée des différentes formes de proximité de manière simultanée ce qui rompt avec les approches dynamiques existantes habituellement centrée sur l'étude de la mobilisation d'une unique forme de proximité .

Mots clés : Conception, innovation, proximités, échelles spatiales d'action

Codes JEL : O18, 031, 032, R12.

Introduction

The spatial character of innovation activities was given a theoretical basis by Griliches' production function (1979), which was built upon Marshall's (1919) idea of "atmosphere". The geography of innovation quickly appropriated the production function approach as a basis for assessing the spatial distribution of spillovers. This approach tended to confirm the hypothesis that knowledge externalities are local (Maillat et al, 1994; Audretsch and Feldman, 1996) and to underline the 1980s' 'dogma' (Torre and Rallet, 2006) that geographical proximity plays a positive role in knowledge transmission.

Although the spatial character of innovative activities can be observed empirically (Madiès and Prager, 2008), it is no longer analysed uniquely in terms of geographical proximity. By integrating the modalities of the externalities diffusion, research has shown that geographical proximity is only profitable when it is associated with other types of proximity, that is, with relational, organised, institutional or cognitive proximity (RERU, 1993; Pecqueur and Zimmerman, 2004; Boschma, 2005). Although most researchers accept that there are several types of proximity, questions remain about the relations between them and about the modalities of these relations. The present contribution represents an attempt to untangle this web of proximities.

Our presentation begins with a brief description of the different types of proximity. Based on the premise that design is the core process in the development of innovations, we argue that this process provides a template for studying the relationship between innovation and the different types of proximity. We tested the validity of this hypothesis via an empirical survey of 800 firms in the Rhône-Alpes Region of France. The results of our survey show that firms call upon different external actors at different stages in the design process, thereby indicating how the various types of proximity coexist and interact, both in the design process and, by extrapolation, in the wider process of innovation.

Multiple proximities

It is difficult to tackle the subject of proximities without referring to Marshall (1870), whose pioneering work provided the foundations for later cluster theories. Marshall used the term 'industrial districts', which he defined as the concentration of specialised firms and complementary firms, whose geographical proximity allows them to interact intensively and to share local labor market. This geographical proximity also produces an 'industrial atmosphere' that generates innovation and that is accessible to all actors within the area.

A theoretical basis for Marshall's idea of industrial atmosphere was not developed until 1979, when Griliches integrated technological externalities ('spillover effects') into his knowledge production function, which he defined as the influence of external knowledge capital on productivity (Griliches, 1979: 102).

We briefly review how the geography of innovation has used this production function to evaluate the spatial diffusion of spillovers. We then look at how the regional sciences came to identify four other types of proximity: relational, organised, institutional and cognitive.

Geographical proximity

During the 1980s, regional economists focused on the impact of spatial proximity, highlighting the importance of geographical proximity.

Initial research found that the co-location of innovative firms and laboratories (in particular) was a favourable precondition to innovation capacities. Firms set up close to one another in order to benefit from technological externalities, which positively affect the knowledge production function through interactions and exchanges of information (Maillat et al, 1994). Extending earlier work on industrial districts, research into local production systems (Becattini, 1990) and innovative environments highlighted the importance of the proximity of actors in creating networks of formal and informal links that promote endogenous dynamics.

Geographical proximity was thereby seen to play an important role in the diffusion of knowledge and innovation and, therefore, in growth. The presence of research centres and universities has an incontestable impact on the regional innovation dynamic (Jaffe, 1989). The importance of geographical proximity appears to be greater when tacit knowledge is essential to generate innovative activities (Audretsch and Feldman, 1996).

As economic geography began to replace the classic view of space with a view that also took into account the relational dynamics between actors, space was less and less considered in terms of constraints. The French *Dynamiques de Proximité* School put into perspective the importance of geographical proximity by proposing that physical proximity be dissociated from other types of proximity created by the socio-economic relations between agents (Bouba-Olga and Grossetti, 2008). The need to dissociate the different types of proximity resulted from the recognition that firms do not have to be located in close geographical proximity in order to innovate together, and that geographical proximity is just one of several dimensions that are capable of promoting interactions and innovation processes.

At the beginning of the Noughties the spatial approach to economic development dynamics advocated by the New Economic Geography (NEG) reopened the debate over the importance of cluster effects on innovation and thus about the importance of the physical proximity of actors combined with the intensity of their interactions. In a context of increasing returns to scale, reducing barriers to exchange stimulates spatial polarisation. Cluster effects reinforce concentrations of capital and work, which makes them more efficient in both static and dynamic terms (Scott and Storper, 2006). These same effects reveal localised relational advantages that favor learning and innovation effects, in parallel with an upstream and downstream dynamic of interconnections between firms in industrial systems. This places learning (which is generally implicit or, to use Polanyi's terms, "tacit" or "unarticulated") at the heart of the geographical dynamic of innovation, with knowledge transfer occurring through regular contacts, experience and intuition (Polanyi, 1962).

Because physical proximity facilitates the exchange of knowledge, it is clearly a factor behind the geographical clustering of innovative activities (Maskell, 2001; Dahl and Pedersen, 2004).

Organised proximity

Studies of the morphogenesis of productive networks (formation, social dimensions relational interdependencies and strategic alliances, …) led researchers to recognise that geographical proximity is not the only form of proximity to affect innovation (Gordon and McCann, 2005). The structuring of innovation activities is not uniquely geographical and limited to pre-existing spaces; it also involves other factors such as the development of networks. In all these approaches, proximity is associated with a dynamic of cumulative interactions that favor the circulation of information within a network of market value and non-market value relationships. The learning process is facilitated by spatial proximity, but space must be seen as participating in this knowledge dynamic because the dynamic involves interactions between agents who have a "contextual" or "situated" rationality (Pecqueur and Zimmermann, 2004).

Relational and organised proximity reposes on the fact that the individuals involved share the same system of beliefs and similar knowledge. Nevertheless, the meaning of the development of inter-relations can be found in the weight of the group of actors, its history and its learning in terms of skills, values and powers. Firms are prompted to favour external relations, to put value on working with certain partners, however physically distant they are. Interactions between agents occur along pathways that are facilitated by behavioral rules and routines, and this creates an observable logic of belonging. This is particularly true of firms that prefer to keep most of the creation process in house, but it is also true when firms conduct their creation processes within well-established networks.

Cognitive proximity

Although it in no way denies the influence of geographical proximity on the accessibility of knowledge, taking into consideration cognitive proximity shows why geographical proximity is not the only condition needed to promote the production of knowledge.

Based on the observation that human cognition is situated and formatted by experiences and social interactions, Nooteboom proposed that actors' relations to innovation are different according to whether the knowledge they have is similar or very different (Nooteboom, 2000).

For him, cognitive distance is a positive factor, as it provides opportunities to learn from others who, due to their own life path, interpret, understand and evaluate the world differently. Thus, an increase in cognitive distance can be advantageous because it provides opportunities for producing new combinations of complementary resources that promote innovation

However, cognitive distance can quickly become an obstacle that creates incomprehension. An actor's knowledge absorption capacity is a decreasing function; hence, an increase in the cognitive distance between two actors leads to a decrease in mutual understanding and a reduction in the benefits gained from any interaction.

This automatically limits possibilities for collaboration. The relation between innovation and cognitive distance appears to be an inverted-U shaped relationship, with the summit of the parabola being the optimal cognitive distance between actors. This distance must be large enough to allow innovation, but small enough to permit effective collaboration, because actors who do not have a similar perception, understanding and values spend too much time and effort clarifying ambiguities, eliminating misunderstandings and defining priorities and directions etc. (Nooteboom, 2000, 2007).

Recognising the different types of proximity involved in innovation is not an end in itself. As noted above, it has helped put into perspective the importance initially accorded to geographical proximity and contributed to the realisation that geographical proximity can be harmful, as it can lead to the homogenisation of knowledge bases and ways of thinking[1]. It also allows researchers to take into account the relations between the different types of proximity: Are they substitutable or are they complementary? Many studies, for example Boschma (2005), have investigated the mechanisms underlying the combination of certain types of proximity.

The present study contributes to this research stream by using a dynamic analysis of the design process to investigate the proximities involved in innovation.

What is the design process?

Our decision to use the design process to analyse the mobilisation of different types of proximity was not made by chance; it was based on the fact that the design process forms the heart of every innovation process. In terms of the dynamics of this process, it is

[1] As Maskell pointed out, novelty is unlikely to emerge "in a world of clones" (Maskell, 2001: 220).

essential to understand whether or not it is confined to a pre-defined geographical area. It is then possible to recognise the various steps in the design process.

Design: The Central Process of Innovation

Inside innovation literature, two main positions can be discerned, depending on whether innovation is seen as a product or whether it is seen as a process through which ideas or information are turned into a new object (Forest, 2010).

Advocates of the first position leads to consider innovation as a product whose effects on a given economic system can be measured; the process by which the innovation is created is not considered.

In contrast with the black-box model, according to the second point of view the most important element is the way the innovation is produced, not the innovation itself. As a result, innovation is no longer analysed from the simplistic standpoint of exogenous technological progress; it is seen as an endogenous process that is both explained by the economic logic and an explanatory factor of the economic dynamic. This view led to the development of an R&D-centred model of innovation, which quickly became the dominant way of representing the innovation process and helped define the orientations of the earliest research and innovation policies, drawn up in the 1950s. The influence of this model can still be seen today in the national and EU objective of spending 3% of GDP on research and development by 2010.

Although the linear and hierarchical model represented a break with the black-box model, the importance granted to R&D has been discussed (Dertouzos et al, 1990; Bonnaure and Barré, 1995).

In fact, as Boschma highlighted, science and technology policy in the European Union is focused on enhancing R&D, and there is “a strong belief that R&D policy will bring benefits to many regions. In reality, (...) much of the newly created knowledge is not exploited economically in Europe but leaks away to countries like the US. This means European R&D policy is subsidizing the exploitation of knowledge elsewhere” (Boschma, 2008: 15).

Realising the excessive importance given to R&D, Kline and Rosenberg’s model (1986) broke away from the linear and hierarchical model of innovation, which made R&D the prime factor. Their model was different in two ways. First, rather than viewing the innovation process in terms of a single path (as is the case for the linear and hierarchical model), it included five different paths[2]. Second, it placed the design process at the centre of the model, thereby rejecting the widely accepted view of the overriding importance of science in the innovation process “The central process of innovation is not science but design”[3] (Kline and Rosenberg, 1986: 286).

[2] The first path, the central axis, represents the design process. The second path represents all the retroactions, the recourse to science during the design process, the radical innovations that are the direct result of the development of new sciences, and the retroactions that can lead to the innovation.

[3] Kline and Rosenberg’s words must not be misinterpreted. They are not claiming that research has no use; they are merely highlighting the fact that not all innovations result from the application of knowledge produced by a research process. This is why they chose to show research as being parallel to the central axis.

Far from being an isolated point of view, Kline and Rosenberg's perspective is supported by respected theoreticians such as Simon (1969) and Argyris (1995), as well as by recent studies that have shown that firms that pay particular attention to design are five times more likely to innovate (European Commission, 2009) and to develop more "novel" innovations (Tether, 2009). Recognising the role of design in innovation has led many European countries, including Finland, Ireland, Spain, Denmark and the United Kingdom, to draw up and implement policies that promote the search for excellence in design (Hollanders and Cruysen, 2009).

Design: A Multi-Stage Process

The need to take into account the key role of design has resulted in a number of models of the design process (Blessing, 1994, Evbuomwan et al, 1996).

Although these models are based on different approaches (product-centred, problem-centred or cognitive cycle models …), they all agree that the design process consists of a series of stages.

Most theoreticians and practitioners recognise the following stages in the design process:

1. Evaluation and selection of ideas: The objective of this first stage is to use the firm's knowledge of its market to identify a promising idea, and to insert this new product idea into the firm's "strategic objectives and business sector" (Perrin, 2001:117).
2. Preliminary reflection: This stage aims to:
   - Understand and clarify the need, in other words, to define the problem,
   - Define the design environment.
3. Feasibility study (preliminary project study): This involves setting up a functional analysis process for the new product. It includes:
   - Listing the different functions to be fulfilled by the product,
   - Looking for possible solutions for each of these functions,
   - Evaluating some of the possible combinations.
4. Search for a global solution: This stage involves finalising and dimensioning the product.
5. Final design: The production of a final design based on the results of the previous stages.

These stages are not carried out by a single, all-knowing actor; they involve a large number of actors with different skills (marketing, R&D, etc.) and who may or may not be members of the firm. A non-exhaustive list of actors includes suppliers and distributors, customers (Lundvall, 1988; Micaelli and Visser, 2005), and research laboratories. These actors are involved at different times and in different stages of the design process.

Accepting that the design process is at the heart of innovation raises the question of the extent to which this process can be considered a vector for the structuring of proximities. Each stage of the design process has its own goal and involves specific actors, but does this mean it can be used as a template for analyzing how the different types of proximity are interrelated? Our empirical study was designed to address this question.

Empirical Study: Presentation and Method

As stated above, we wanted to determine whether or not the design process can be used to analyse the dynamic relationships between the different types of proximity described in Part 1. We tested the empirical robustness of this hypothesis via a statistical analysis of the qualitative data on innovation obtained via a survey of firms in the Rhône-Alpes Region of France.

Data Base

We chose the Rhône-Alpes region for our study because it occupies second place in France's R&D score table, spending €4.2 billion (11.9% of domestic R&D spending) and employing 21,065 full-time equivalent research staff (11.5% of the total for France, OST, 2008). Rhône-Alpes is one of the regions in Europe that spends more than 2% of its GDP on R&D. Among European regions, it occupies 5th place for its technological and scientific potential and 8th place for scientific publications.

We identified innovative companies within Rhône-Alpes via the Regional Development and Innovation Agency's (ARDI) database. This database allowed us to compile an initial list of 1122 potential contacts, including firms from all six of the Agency's departments. Verification of the list (e.g. filtering multiple contacts within a single company, removing incorrect email addresses and detecting contacts who had changed companies) led to the removal of 322 contacts, leaving a total of 800.

The survey was carried out online using SphinxOnline survey and statistics software. Emails were first sent out at the end of February 2008, followed by two reminders ten days later. Responses were received from 115 contacts[4].

The verification process showed that the firms contacted were innovative: 94.7% of respondents stated that their firm develops product innovations, 40.4% develop process innovations and 11.4% packaging innovations. These figures are much higher than the national average, as, according to an innovation survey carried out by the SESSI (French government industrial studies and statistics service), only 44% of industrial companies with 20 or more employees introduced product or process innovations between 2004 and 2006.

Panel

Our panel showed that our respondents were members of:

- Industrial companies (58% stated that their company's business was industrial), which is unsurprising given that industry remains an essential component of economic activity in Rhône-Alpes, France's second most important industrial region.
- Mostly small companies (47.1% of the firms had less than 100 employees) that are often parts of a larger group (43 different groups for the 115 responses),

[4] The return rate was 14%, which is consistent with the mean return rate for this type of survey.

which is in line with the industrial make up of Rhône-Alpes and a specific feature of the region (DRIRE[5], 2007).

- From a wide range of sectors. Fourteen percent of responses were received from firms that make production goods (this is also the largest industrial employer in the region), 9% of responses were from industries related to electronic equipment (6th largest employer in the region), and 7.5% of responses were from 'sports equipment' industries (which, again, is in line with the industrial landscape of Rhône-Alpes).

Measures

The data were processed using SphinxOnline software, which includes a number of advanced statistical processing tools. As well as statistically sorting the data and presenting them in tables, we used a standard Chi2 test to determine the significance of the indications given by crossing the qualitative responses.

We used factor analysis (Multiple Correspondence Analysis) to provide a clear visual representation of the results. Correspondence Analysis is a powerful technique for synthesizing several variables and thereby revealing the influences and systems of relations between them. It can also be used to produce maps showing the relationships between the different modalities of the qualitative variables. These maps allow multi-dimensional datasets to be represented in two dimensions while preserving as much of the information as possible.

Our analyses provided a new perspective on how, when and why firms decide to involve external actors in the design and innovation process. The processing of objective data about innovation is nothing new however; the novel aspect of the present study is that it allowed us to focus on the ways in which members of firms view the process and dynamic of design.

Results: the design process as a space for structuring proximities

The results of our empirical study support our proposition that the design process can be used as a template for studying proximities. By shining new light on the web of proximities, studies of the design process can reveal how the different proximities overlap and how they interrelate, thereby calling into question public policies that apply the same recipes to all types of clusters.

Different External Actors for Different Stages and Different Operations within the Design Process

The first lesson that can be drawn from our survey concerns the use of external actors within the design process. Although the firms stated that they only occasionally involve external actors in product R&D (56% of respondents said this occurred "sometimes"),

[5] Regional Directorate for Industry, Research and the Environment

they also stated that customers, who are the most frequently called upon external actors (86 out of 496 responses), are closely involved at the ideas evaluation and selection stage (including the market survey). Marketing agencies and designers are more commonly associated with the preliminary reflection stage, as part of the needs identification process, which is unsurprising given the nature of the process. Suppliers and research laboratories are most frequently associated with the feasibility study stage, whereas consultancies are most commonly brought in at the final design and production design stage.

Our survey showed major differences in the logics governing the mobilisation of the different types of external actor. A “common interest and sharing a vision” (46 responses) was the most important factor for involving customers in the design process, with geographical proximity being a significantly weak (12 responses) reason. Research laboratories are primarily based on the ‘need of their knowledge’, whereas the choice of marketing agency is largely leaned against reputation. As very few firms employ specialist ergonomists, this is another field in which they call upon external actors. In this case, the only factor governing the choice of actor is expertise.

Unsurprisingly, contacts within a professional group were found to be mostly made through networks of professional associations.

These results support two hypotheses. First, our survey provides empirical validation for using design as a template for understanding the innovation process. Second, decisions to involve external actors in the design process are governed by a number of different logics.

Interrelations between proximities

We also wanted to verify the existence of a correlation between the mobilisation of different external actors, stage in the design process and the logic behind the mobilisation. The resulting Figure 1) shows some very significant correlations (TS=32).

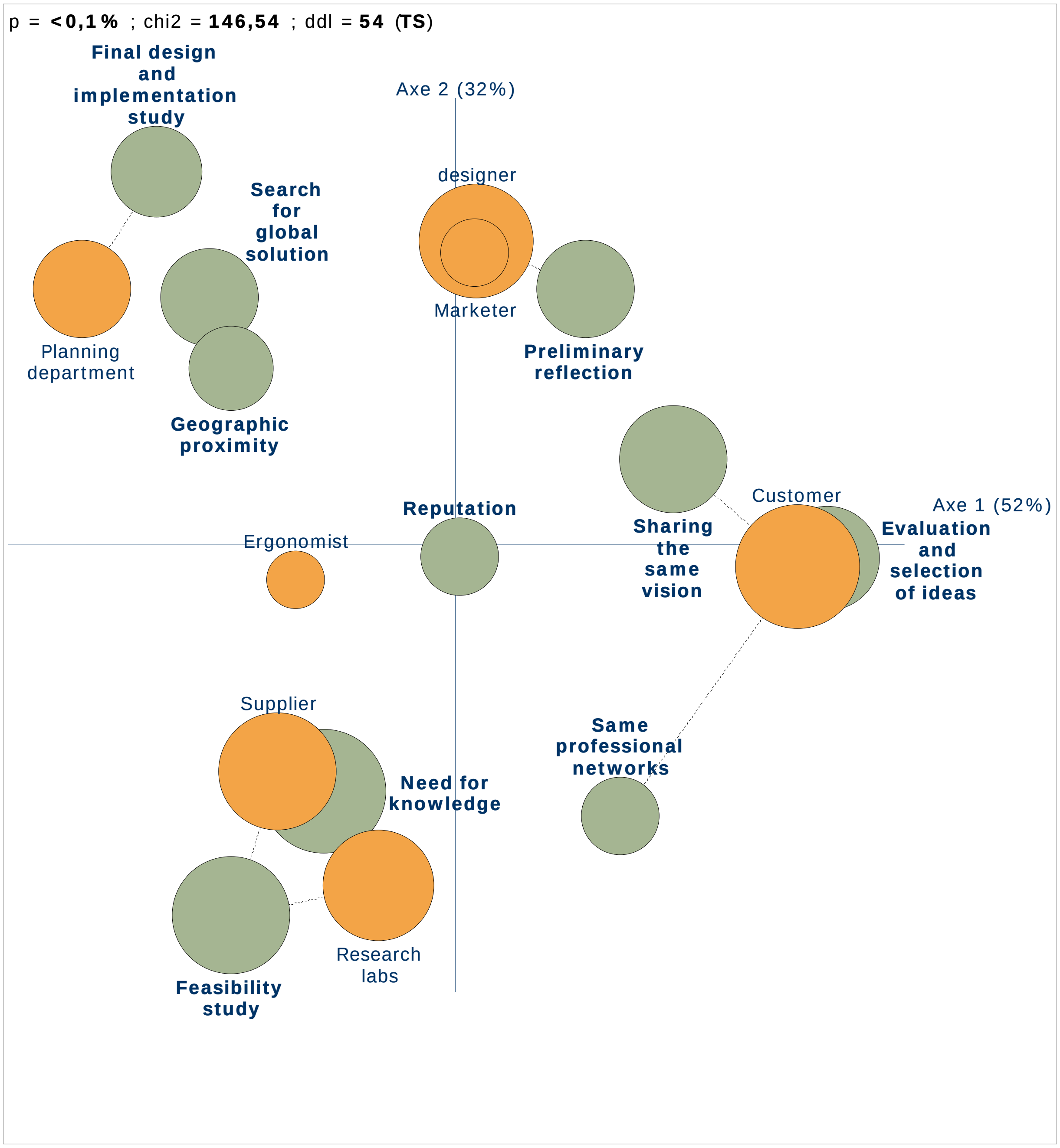
Axis 1 is revealed to be the discriminating axis because it includes 52% of the information. Thus, the second lesson that can be drawn from our study concerns the overlapping positions of certain actors depending on the design stage and the logic of mobilisation. The overlap between the different types of proximity is not a chance effect - because each stage in the design process has its own objectives, it requires the involvement of specific actors whose mobilisation depends on a variety of proximities.

Our study suggests that the choice of external actors is not always based on the same criteria; in other words, it obeys differentiated mobilisation logics (Figure 1).

Our results show that the mobilisation of customers in the upstream phase of the design process (evaluation and selection of ideas) is closely linked to “sharing the same vision” (of the product to develop, the target market …). As we noted in the first section, this reduces misunderstandings and facilitates the definition of priorities; therefore, from the point of view of our respondents, cognitive proximity is the discriminating factor in the first stage of the design process.

Geographical proximity plays a minor role in the initial stage of the design process; it is only seen as a determining factor in the search for a solution stage. Our results also indicate that geographical proximity is not a necessary condition in the exploratory stages, which are characterised by a desire to acquire new knowledge from any source.

FIGURE 1 Stages and Logics Behind the Mobilisation of External Actors



On the other hand, organised proximity combined with membership of the same network is not clear, or at least does not appear to be clearly attached to any particular stage of the design process.

Our results support the conclusions of a number of previous studies that have shown that innovation is influenced by a combination of different types of proximity (Boschma, 2005), and that the importance of each type varies according to the stage within the design process. This suggests that previous studies of proximities have lacked a dynamic vision that would allow researchers to ascertain the role played by each of the different types of proximity "in the life cycle of innovation" (Rallet and Torre, 2006).

Although the present study revealed the most important proximities in each stage of the design process, these are not necessarily the only proximities that come into play in these stages.

Conclusion

Considering innovation from the point of view of its central process, that is to say, design, enabled us to:

- Demonstrate that different external actors are involved at different stages in the design process and,
- Determine how the different types of proximity coexistent and how they interrelate within this process.

Thus, studying innovation from a design point of view allowed us to confirm the proposition that "geographical proximity will be mobilised in different ways and to different extents according to the stages in the collaboration process" (Rallet and Torre, 2006). However, it also allowed us to go further, as it appears that this conclusion is valid for all types of proximity, and that it is possible to simultaneously consider the differentiated mobilisation of these different types and to better understand how they interrelate.

Further studies must now be carried out to determine whether or not our results can be replicated and/or extended. Moreover, our study did not enable us to determine whether there were statistically significant differences in the responses provided by firms from different industrial sectors. It is highly likely that such differences exist and, if they do, they may explain why French business clusters in different domains do not mobilise the same types of proximity.

Our research also needs to be refined by considering the mobilisation of actors as a function of the type of innovation project. Would "exploration" projects produce similar results to "integration" projects? Further work is needed to shed light on this interesting question.

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