Territorial assemblages simulation for territorial intelligence

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TERRITORIAL ASSEMBLAGES SIMULATION FOR TERRITORIAL INTELLIGENCE

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Summary : The following article is based on the theory of assemblage ontology seen as a framework to formalize new projects territories in a perspective of territorial intelligence. The area of research is PARIS-SACLAY Campus, which views the development of a world science cluster. The assemblages are simulating by means of simplicial complexes. Its objective is to offer new decision-making tools to territorial community.

Mots clés : agencement, intelligence territoriale, complexe simplicial, participation.

Keywords: assemblage ontology, territorial intelligence, simplicial complexe, participation.

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1. TERRITORIAL INTELLIGENCE AS A FRAMEWORK FOR TERRITORIAL ASSEMBLAGES SIMULATION

Territorial intelligence is an emerging concept highly polysemous. It has been suggested in the European Community (EC) context the term of "territorial intelligence" in 1998 to illustrate an approach of development of territories based on a scientific, systematic and multidisciplinary approach, which uses technologies of information and communication, integrates multi-criteria methods and spatial analysis that involves practitioners in the observation process and interpretation of results. "The concept of territorial intelligence represents the set of multidisciplinary knowledge which on the one hand contribute to the comprehension of structures and territorial dynamics and on the other hand aims at being an instrument for the actors of sustainable development of the territory" (Girardot, 2002, see 2009).

The territorial intelligence lived on economic sciences and geography, but also on sciences and technologies of information and communication (STIC) and on knowledge management. The connections with the economic intelligence and the STIC are often at the core of common definitions of the territorial intelligence. The systems of territorial intelligence make use of the traditional means of spreading information and use the technologies of information and communication through Intranet and Internet sites, documentation, systems of geographic information and data analysis. In the scientific field, the territorial intelligence integrates and develops the multi-disciplinary knowledge and the scientific protocols essential to the understanding of territorial structures, territorial systems and territories' dynamics.

The territorial intelligence evaluates the governance principles, which guarantee a balanced consideration of needs, a fair distribution and the perpetuity of resources thanks to partnership and participation. The governance is different from the government in that it represents a temporary framework allowing assembling public, private and associations' actors, who cooperate in order to define concrete common objectives and who coordinate their resources in order to fulfill these objectives in a reasonable and functional way, that is to say, respecting the sustainable development principles. In other words, and like the community development, the territorial intelligence respects two ethical principles resulted from the sustainable development: the citizens' participation and the actors' partnership. However, contrary to the concept of community development, the territorial intelligence is based on the use of technologies of information and uses the tools of territories knowledge and of analysis of territorial information in the context of the knowledge society.

Finally, the territorial intelligence designs and realizes tools for, with and by the territorial actors that aim at developing their territories in the respect of the principles of sustainable development and of democratic governance.

In conclusion and as we can see on the portal of the European Network of Territorial Intelligence "the territorial intelligence is the science whose object is the sustainable development of territories and whose subject is the territorial community" (http://www.territorial-intelligence.eu/). It is also a collective intelligence that associates the competences in a cooperative way so as to increase, to create and to evaluate innovative, adapted and long-lasting projects. It comes out of a transfer that enables the access on a larger scale to knowledge. For this, it involves training, covering, co-building of knowledge, sharing information. It rallies firstly the territorial actors, the development partners. In the end, it is intended to the entire territorial community.

Territorial intelligence will help coordinate dimensions of sustainable development largely involving everyone in the development of its own well-being, of its community on its territory, and of the humanity on the planet. If this concept is highly attractive, how could we represent a so complex structure of people, computational agents, and organizations? This is why our research group sought to find new concept to keep a better sense of how collective intelligence could be explored and visualized.

2. TERRITORIAL INTELLIGENCE AS ASSEMBLAGE OR ACTOR-NETWORK

As Hutchins said "the cognitive properties of human groups may depend on the social organization of individual cognitive capabilities" (Hutchins, 1995, p. 176). The key idea here is that intelligence is a product of interconnectivity. It emphasizes the "social" aspects of cognition. More specifically, different forms of network have different cognitive consequences. But loosely connected systems can be variously organized (Weick, 2009, p. 54) and, above all and in a more general way, conceptualized. And this is the central point.

These last decades, new theories have turned around the best way to conceptualize (anew) what the "social" could be and gained visibility in recent years. Some philosophers tried to conceive a topology of multiplicity in relation to a high spatial concern: Michel Foucault in his criticism about space conceived an area of "disciplinary" apparatus; Gilles

Deleuze in his approach of "arrangement" or "assemblage" thought as multiplicity generating de-territorialization and reterritorialization processes; Peter Sloterdijk and his concepts of spheres: "foam" or "envelope" - as opposed to rooting, enhancing speed urban stimulations, air de-territorialization and figure of pluralities of spaces such as "anthropogene islands" or "anthropospheres". Among sociologists, Giddens stressed space and time dissociation in modern societies. Modernity breaks the bond between social activity and its localisation in some peculiar contexts of presence: social systems delocalization characterizes the extraction of social relations from the local context of interaction and their reorganization in indefinite space-time contexts. Information technologies reinforce the dismantling of space compared to place in favour of an unlocalized capacity, a wandering power, which authorizes a multitude of changes.

Lastly, let us mention the work of Michel Callon and Bruno Latour on the Actor-Network Theory (ANT). Their analysis takes into account the actors as well as the objects (or agency of "nonhumans" actants) and the discourses. The ANT assumes that what makes the social is "association", the formation of "collectives" and all the relations and mediations which make them hold together. These relations are established by an operation of "translation" or chains of translations (successive transformations) by which actors (individual or collective) are defined as spokespersons (or delegate actors), translate the will of collectives and also try to enroll new actors. In this way, the social is understood as being an effect caused by the successive interactions of heterogeneous agents, i.e. of the actor-network. The relative stability of an actor-network results from the strength of the relations and the mediations which make hold together heterogeneous collectives composed of actors, objects and discourse (but also of its size or length). But it can constantly collapse if some agents are withdrawn from the network.

More largely, the problem raised by the representation of these new forms of collective intelligence seems to be coined as a (new) *social ontology* paradigm, initiate by Foucault then Deleuze[1], and continued by new currents of continental philosophy and (to a lesser extent) sociology, in particular in the writtings of Alain Badiou, Bruno Latour and Michel Callon, Peter Sloterdijk, Slavoj Žižek, Manuel DeLanda, Theodore R. Schatzki or Graham Harman. Against the reduction of philosophy to an analysis of texts or of the structure of consciousness, brought by what Quentin Meillassoux proposes to named "correlationism"[2], there has been a recent surge of interest in properly ontological questions, toward an asubjective, new materialist and realist ontological vision, especially in a social realm.

To be exhaustive, another well-known current, coined as a "practice turn" (Schatzki, Knorr Cetina and von Savigny, 2001)[3], try in a same realist and materialist way to account of the social reality as a set of sociocultural practices articulated in different fields. The basic claim is of situatedness of everyday activity which implies to admit the *relational* character of person, knowledge and learning, activity, discourses, artifacts and social world which, under the practice umbrella, produce and reproduce the social order. The notion of situated activity assumes that subjects, objects, lives and worlds are made in their relations. As the others assemblages theories, social practice theory is a theory of relations (Lave, 2011, p. 2). "That is, the contexts of people's lives aren't merely containers or backdrops, nor are always they simply whatever seems salient to immediate experience. Persons are always embodied, located uniquely in space, and in their relations with other persons, things, practices, and institutional arrangements" (p. 152).

[1] Enlightened by Whitehead and more generally what it has be called "Process Philosophy" (or ontology of becoming) which identifies metaphysical reality with change and dynamism (See Rescher, 2001).

[2] Correlationism is "the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other". This position tacitly holds that we can't really have experience of the world (or in knowledge of reality) independently of thought or language. The origins of this correlationist turn lie in Kant and his successors, from Husserl to Heiddeger to Derrida and, of course, many of cognitive scientists, even those which think that the cognitive system involves coordination between internal and external (material or environmental) structure.

[3] Whose most famous representatives in recent period are Pierre Bourdieu (1977) then Antony Giddens (1979).

In short, what we try to do here is to reframe all these fragmented insights in a coherent framework – called *assemblage theory*[4] – and operationalize it with some relevant mathematical techniques, called simplicial complex theory, as it was first applied by Ron Atkin to the realm of social affairs (Atkin, 1977) to solve the problem of multidimensionality of any social entity. Then, we have applied it to collective intelligence's problems which appear in the field of the territorial intelligence.

So, what is an assemblage, an arrangement or an actor-network? Foucault defines an "apparatus" following: "What I'm trying to single out with this term is, first and foremost, a thoroughly heterogeneous set of consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral, and philanthropic propositions – in short, the said as much as the unsaid. Such are the elements of the apparatus. The apparatus itself is the network that can be established between these elements (…) By the term "apparatus" I mean a kind of a formation, so to speak, that at a given historical moment has as its major function the response to an urgency. The apparatus therefore has a dominant strategic function (…) I said that the nature of an

apparatus is essentially strategic, which means that we are speaking about a certain manipulation of relations of forces, either so as to develop them in a particular direction, or to block them, to stabilize them, and to utilize them. The apparatus is thus always inscribed into a play of power, but it is also always linked to certain limits of knowledge that arise from it and, to an equal degree, condition it. The apparatus is precisely this: a set of strategies of the relations of forces supporting, and supported by, certain types of knowledge" (Foucault, 1980, 194-96).

[4] Foucault translator proposes to translate "agencement" by "assemblage" in English whereas in (Latour, 2005) the same notion is translated by "arrangement". But (Çalışkan, K, Callon, M., 2010) keeps the term "agencement": An actor, said Callon and Çalışkan "is made up of human bodies but also of prostheses, tools, equipment, technical devices, algorithms, etc'. – in other words is made up of an agencement". An agencement is thus an assemblage, arrangement, configuration or lay-out. On the other side Manuel DeLanda maintains the term "assemblage" in his "New Philosophy of Society: assemblage theory and social complexity" (2006) whereas Schatzki T. R. (2002) preserve also the term "assemblage" when he speak about Deleuze and Guattari work, but prefer "social arrangement" to coined his own theory.

Contrary to Foucault who seeks through the figure of the apparatus to make the idea of structure more dynamic (in structuralism sense), while preserving however the assumption of a certain homogeneity of the elements which are connected, Deleuze will build the differential of the forces which are embodied in assemblages/agencements starting from an assumption of radical heterogeneity of their components. "Structures are linked to conditions of homogeneity, but assemblages are not (…) What is an assemblage? It is a multiplicity which is made up of many heterogeneous terms and which establishes liaisons, relations between them (…) Thus, the assemblage's only unity is that of *cofunctioning*" (Deleuze, G. and Parnet, 2002,).

The main (but crucial) difference among us is that as Foucault stays in a neo-structualist posture where, in apparatus, entities in relation are linked by internal relations to form a whole as totality (*relations of interiority*), Deleuze calls assemblages wholes characterized by *relations of exteriority* (DeLanda, p. 10). Thus, any social entity, on any scale (person, interaction, interpersonal network, City, State…) can be described as an assemblage (or an arrangement, or an actor-network) which offer us a true alternative to organic totalities. In particular, any assemblage could be seen as resulting of an emergence starting from complex interactions between heterogeneous and autonomous components parts. Assemblage theory makes it also possible to posit social entities on all scales, from sub-individual to transnational, making the problem of the link between micro- and macro-levels of reality non relevant in this 'flat ontology' perspective (Marston and al., 2005).

Latour pushes these intuitions to the limit in the Actor-Network Theory (Latour, 2005). Here, an active entity (an agent or actant) is defined neither by itself (identity, essence) nor by its relations (its network). This apparent paradox is possible because the question of the actors and their network is always empirically untied, during trials in which agents, and mediations on which they rely on, operate translations enabling them at the same time (or not) to enter in relation, and to be defined as acting individual and collective entities. The dynamic "mediation-translation-trial" associates (according to to the principle of Generalized Symmetry), Latour and Callon give an account of any phenomenon as a progressive aggregation of a plurality of "heterogeneous entities". This aggregation is able to stabilize itself during a trajectory, and thus forms a "whole" of associated heterogeneous elements. At the beginning of the situation of analysis, agents are empty. Gradually, their own action and the action of the other agents equip them with heterogeneous and not inter-dimensions which are themselves heterogeneous) and stabilizes an initial plurality of heterogeneous entities according to a certain trajectory.

By radicalizing the idea that any materials, attributes or types of bonds can belong to an actornetwork - human as well as nonhuman (according connected attributes. Through mediations and translations, entities get themselves associated into situations where they are defined by the modifications (translation) they realized on each quality that defines them. Simultaneously, actors are definable only starting from some lists of relations or attributes which very distant from what we can image actors are. In short, heterogeneous entities assemblages or arrangements should ideally been visualized simultaneously starting from their activity and their relations. However, if one starts from agent, one will note the immediate metamorphoses of his identity. And if one starts from his attributes - "structure" - those will be permanently modified by his activity. The necessity of presenting these two movements simultaneously leads to a formal difficulty that we will try to solve in the mathematical section.

On the practice theorists' side, Theodore Schatzki tries to articulate arrangement theory with practice theories (Schatzki, 2002). For him, orders are arrangements of entities (e.g., people, artifacts, things), whereas practices are organized activities. So "human coexistence thus transpires as and amid an elaborate, constantly evolving nexus of arranges things and organized activities" (p. xi). So "an arrangement is a hanging together of entities in which they relate, occupy positions, and enjoy meaning (and/or identity)" (p. 19). If order is a basic dimension of any domain of entities, orders as arrangements need "context", and practices are contexts for any social system (or social orders).

The main (but crucial) difference between new practice theories and pure arrangement theory, especially that of Latour, is that the latter is a social nominalism and the former contextualism. According

to nominalist theories of assemblage, the meanings and positions of the components of assemblages depend solely on properties as well as relations between these components. Contextualists contend, by contrast, that the layouts, positions, and meanings of social entities derive in part from a context composed of social practices. By "context", they usually mean, roughly, a setting or backdrop that envelops entities and helps determine their existence and being. Finally, assemblages necessarily exist in heterogeneous populations, which forms there context. The relationship between an assemblage and its components is complex and non-linear: assemblages are formed and affected by heterogeneous populations of lower-level assemblages, but may also act back upon these components, imposing restraints or adaptations in them.

In spite of these different theoretical breakthroughs, the representation of these structures, whatever they are, is difficult. So we will illustrate an application of our model based on a concrete case of cluster the project of the Paris-Saclay Campus Project. Then, we will present formal tools allowing the modeling and the simulation of territorial assemblage, as a trigger for a new form of collective intelligence in the perspective of territorial intelligence discipline.

Our assumption is that the concept of assemblage is generic enough to promote the idea that the interaction between social objects does not depend on metaphysics of unity (territorialized space around a central force of power) or substance (perdurant identity of entities in interaction). Conversely, it depends on a movement, a multiplicity which comprises many heterogeneous terms and which establishes connections, relations between them, through dimensions which are themselves heterogeneous. The assemblage is what makes it possible to flee, by delocalization, any territory (or identity, or on substance), for the benefit of movement (and of becoming). This conceptualization synthesizes the work of Foucault, Deleuze and Latour that we gather under the term "Assemblage Theory", where the treatment of multidimensionality, formal as well as empirical, is the main issue.

3. THE PARIS-SACLAY CAMPUS AND VSB PROJECTS AS ASSEMBLAGES

"Grand Paris" is a project aiming at transforming Paris and its suburbs into a large world and European metropolis of XXIst century. It will cost approximately 20 billion euros in investments, according to the government's calculations. It will place the Ile-de-France area in the leading bunch of the first five world-cities, along with New York, London, Tokyo, Shanghai and Hong Kong. In relation to the "Grand Paris" projects, an Operation of National Interest (OIN) plans the creation of the "Plateau de Saclay" Campus as a territory with high scientific and technological potential. It will be a

pole of research and innovation of world rank, similar to the Silicon Valley. This project will benefit from an exceptional investment of a billion euros. This investment has been made possible by the National Loan, for a total cost estimated at three billion euros. This initiative implies the moving of some research institutes from their current territories to Saclay. In connection with this initiative which implies moving research institutes currently installed in their territories to Saclay, local politicians from territorial collectivities separating Saclay from the capital imagined in their turn to gather their efforts to form a territory baptized "Scientific Valley of the Bièvre" (VSB), complementary to "Paris-Saclay" cluster which they wish to promote within the political dynamics of "Grand Paris".

This economical context offers the opportunity to study two projects of new territories, both competitive and complementary. In others articles we analyzed in detail and from a comparative point of view the descriptive categories mobilized by their concerned promoters to expose these two projects, with a particular stress on the VSB. We studied many documents available on "Grand Paris" project, the prefiguration document of the project of the Saclay cluster (nov. 2008), and finally the documents produced by the conferences "Assises of the VBS" (in particular the 4th one held on June 2010).

The analysis made it possible to apprehend the on-surface attributes characterizing the two assemblages. To go beyond this first analysis, we use the concept of "Heterotopia" (space) proposed by Foucault in a text entitled Of Other Spaces (1967) (http://foucault.info/documents/heteroTopia/foucault.heteroTopia.en.html). We asserted the idea that heterotopias precede assemblages such as we defined them in previous section. Indeed, unlike the Utopias, the Heterotopias are existing places but which, as predicted by the assemblages theory, are performative arrangements of heterogeneous entities. These are spaces of otherness, which are neither here nor there, that are simultaneously physical and mental.

The principal limit of our study was due to the nature of our data: data resulting from the projects communication documents tend to erase the movement of association of the entities involved in the assemblage of the projects of new territories. A second test of the Assemblage Theory was therefore elaborated by using the Google™ search engine and starting from key words relate to the projects headings, scientific disciplines, political actors and organizations. The ranking offered by Google™ enable the analyst to identify the multitude of actions (and discourses) which express existing modes that are at the origin of the heterogeneous attributes which will be able, in a second time, to become the attributes (or list of relations) of the agents involved in the studied assemblage. We analyzed five results pages in the surrounding of the terms related to the projects. Hereafter we find the extract of a request (in French).

EDF confirme l'**implantation de son principal site de R&D** au sein du cluster Paris-Saclay, dans le quartier de Palaiseau
Après une longue gestation, le Campus de Paris-Saclay a connu une **impulsion déterminante en 2007 grâce à l'opération Campus lancée par le Président de la République**
Comme l'ensemble du cluster Paris-Saclay, le quartier de l'Ecole polytechnique se doit d'**être exemplaire en matière de sobriété et d'efficacité énergétiques**
Le Cluster Paris-Saclay est créé pour **faire fructifier les interactions** entre l'enseignement supérieur, la recherche et l'industrie **au service de la création de start-up innovantes et de la croissance**
Notre commune (Jouy en Josas), située à 17 kilomètres de Paris, est aujourd'hui **englobée dans les 49 communes retenues dans le projet de loi portant création de l'établissement public de Paris-Saclay**
Modification des dispositions du Titre V relatives à la création du cluster Paris - Saclay - art. 22 - composition du conseil d'administration du futur Etablissement public de Paris - Saclay
En juillet 2008, la Ministre de l'Enseignement supérieur et de la Recherche demande aux différents acteurs de **s'engager en répondant aux remarques du comité d'évaluation de l'opération campus**
La mission de préfiguration de l'établissement public de Paris Saclay souhaite **faire réaliser une étude pour une programmation stratégique du territoire du Cluster Paris - Saclay**
Parmi les éléments importants de ce dossier (Campus Paris-Saclay) figurent la **rénovation** de l'Université Paris-Sud 11
La **réalisation du tronçon intermédiaire**, de l'École Polytechnique au CEA, puis à l'entrée de Saint Quentin, est **programmée pour 2013**

Figure 1: Extract from Google™ search « Vallée Scientifique de la Bièvre » (30/09/2011).

The preceding table shows the links between attributes (generated by actions) and agents. Some attributes are relatively awaited, others less. Even if it is only an extract of the complete result of the request carried out on Google™, one already sees certain variety of the attributes and relations. The attributes common to several agents connect these agents and potentially modify the form of the attributes (structure and dynamics).

Figure 2: Table of actants and associated propositions.

Let us take the example of the proposal "establishment of a site of R & D in the district of Palaiseau". It emerges from the connection of four agents: "EDF", "R & D", "Cluster Paris-Saclay" and "District of Palaiseau". It can in addition be positioned on a chart (district of Palaiseau on the territory of the cluster). Another example is the proposal "being exemplary sobriety energy efficiency" which emerges from the comparison of the agents "cluster Paris-Saclay" and "District of the polytechnic school" which can also be positioned on a chart. Both clusters formed by "establishment of a site of R & D in the district of Palaiseau" and "exemplary being sobriety energy efficiency", populated their actants in relation, present a common element "cluster Paris-Saclay" and consequently a strong bond. In mathematical terms, "establishment of a site of R & D in the district of Palaiseau" and "exemplary being sobriety energy efficiency" forms two simplexes with a common vertex. The whole of the proposals, agents and relations forms a simplicial complex (figure below).
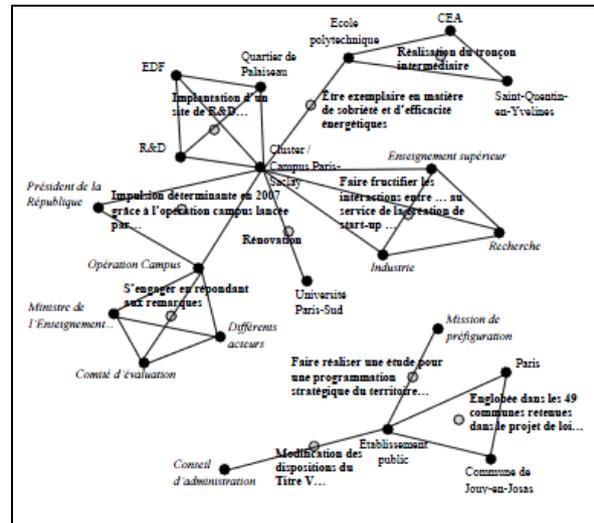

Figure 3: Simplicial Complexe of our Google™ query.

The problem, as we can see from this example, is the insufficiency of the binary relation which is at the base of the graph theory when representing the forming dynamics of an assemblage. It is necessary indeed to go through *n* relations themselves *multiple dimensions*, and thus to use new mathematical methods generalizing the graphs concept, in parallel to hypergraphs. In the following section, we present the formalism of the simplicial complex, which we adapted to modeling and simulation of territorial assemblages. In mathematics, a simplicial complex is a topological space of a particular kind, constructed by "gluing together" points, line segments, triangles, and their n-dimensional counterparts.

4. MODELING AND SIMULATION OF TERRITORIAL PROJECTS USING SIMPLICIAL COMPLEXES

An assemblage, contrary to the binary relations usually described in the graph theory, is defined by a large volume of the elements which enter in composition (non-binary relations). The heterogeneous entities form a "system" because their links are based on some relations of dependences, which are themselves heterogeneous. We will focus on the way of using the technique of the simplicial

complexes to follow and show assemblages such as the "Paris-Saclay" Campus project.

We look for an algebraic approach for the representation of collections (structures) of heterogeneous elements (ingredients) and heterogeneous relations (connections and dependencies), but also for the representation of movements and possible pathways (dynamics). This approach should also allow considering the construction of a territorial assemblages description tool for the modeling and simulation of cities.

The simplicial approach (Fig. 5) appears as an interesting mathematical theory. Particularly developed by Johnson, and Legrand, this framework provides a formalism of spatial representation of knowledge based on the Qanalysis (i.e. the representation and analysis of binary relations introduced by Atkin in 1977) and algebraic topology. This technique has been used, among others, for: research in urban planning, social network analysis, knowledge representation, content analysis, design or, more generally, systems analysis. Its application to territorial assemblages allows a representation in a geometric form (Fig. 4 from the bottom to the top):

-The heterogeneous ingredients as "vertices" (parts);

- The combination or coordination of these entities within active entities in a "simplex" (micro wholes);

- The combination or coordination of these active entities in a territorial assemblage as a "simplicial complex" (macro wholes);

- The territorial construction reality as "paths". Mathematically speaking, a simplicial complex is a set of simplices and faces (Fig.5a) and each simplex is an object represented by a collection of attributes or entities to which it is associated/ connected in a particular dimension (Fig.5b).
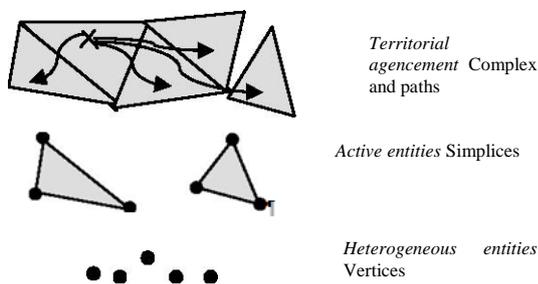

Territorial agencement Complex and paths

Active entities Simplices

Heterogeneous entities Vertices

Figure 4: Abstraction levels in a territorial assemblage model

In our work, each simplex is an active entity emerging from social, cognitive, mechanical, etc. relationships between the involved elements. These connections between entities and between simplices form a "path of connectedness" or "polygonal chain" (Fig.5e). Each elementary step of the chain corresponds to an elementary transformation; the complete chain represents the composition of elementary transformations, then the global transformation. So, we capture a territorial agencement as an area of possible changes. The complexity of one active entity (ie. the profusion of attributes and their relations within one active entity) can be analyzed as a complex node revealing a need to simplify this part of the territorial situation. In the same way, the lack of connection between two actives entities (two simplices) can be analyzed as a structural hole or break of connexity (Fig. 5f) revealing a potential opportunity within the studied territorial situation (ie. the possibility of imagining an entity or technical support that could cover the hole and, thus, link the active entities).

Such a graph is built in two stages: the network description (structure/"backcloth") with vertices and scores, and the description of dynamics ("traffic") which is specific to that network. The structure remains abstract but the traffic is a computational research (Legrand, 2002) indicates some calculations: measure of the degree of intersection between alternatives, measure of the similarity between several connected simplices that are involved in the sequence length, etc.). The topology of the structure and the characteristics of each of its vertices affect the traffic. (Johnson, 2009) goes further by offering the distinction of different relationships between a given pair of points or set of points (Fig.5c). The result is a hypergraph that generalizes the concept of a relation between two things to relations between many things. Johnson gives an example of a hats network whose relations may be related to style or cost. It then defines two binary relations and Rstyle Rcost. This is a key point for the representation of territorial assemblages in which relationships are of various kinds. Johnson's work also provides an interesting look on the inclusion of the time issue in the emergence of such a structure (Fig. 5g), "Simplices provide a way of defining multilevel structure. This relates to system time measured by the formation of simplices as system events" (Johnson, 2009). We can therefore consider following the emergence of an assemblage and its trajectory step by step.
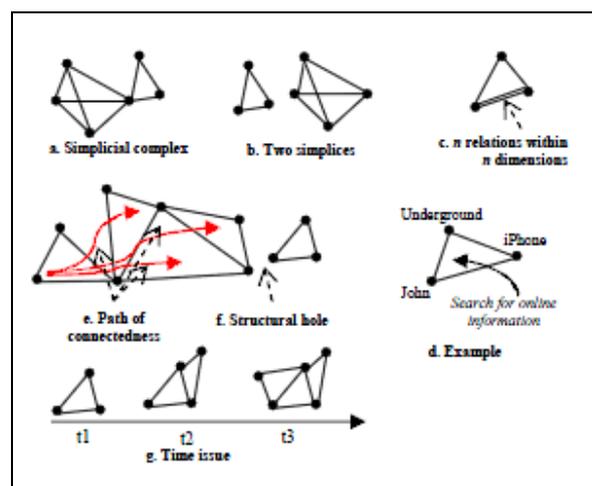

Figure 5: Main notions of the simplicial.

If we take again our previous Google™ query (figure 1 and 2), and apply the simplicial approach we note (in mathematical terms) that "4th assises" and "VSB" form two simplices with a common vertex (that could have been n common vertices or faces). All agents,

The territorial assemblages as simplicial complexes make it possible to see the proposals which emerge of the analysis of the actants and to discover the state of their effects. From this technique of exploration and visualization, it is possible to locate:

-The representativeness of a viewpoint which depends on how many actors subscribe to it. A statement or an argument shared by many of the actors of a public debate deserves more visibility that one that is relatively marginal.

-Their influence. The numbers of allies a viewpoint can mobilize is not the only criterion for deciding its relevance, but actors occupying influential positions deserves a special attention because they will shape propositions or decisions.

-Their interest. Presence of disagreeing minorities is sometimes a mark of potentially new insights in the 'making of' of the collective intelligence, by refusing to settle with the mainstream and reopening the black boxes of what topics could be important.

Thus, it can be possible to consider the optimization of the assemblage to obtain a common and stabilized view of the "strongest" proposals. It is possible to identify a missing key actant or on the contrary an actant to be withdrawn from a cluster, while increasing or decreasing the force of certain bonds

The form of expected collective intelligence relates to:
- The evaluation and the classification of the services actual/could be provided;
- The expression and establishment of a hierarchy between the needs;
- The arbitration concerning the localization of the services on space/balance between supply and demand.

To improve the use by the actors of our tool of collective/territorial intelligence, we have to represent the disputed facts (or "matters of concern" in Latour vocabulary) resulting from the analysis of the simplicial complexes in a tool from an open source geographic information system (GIS) named Quantum (http://www.qgis.org/)using also free resources map coming from OpenStreetMap project (http://www.openstreetmap.org/).
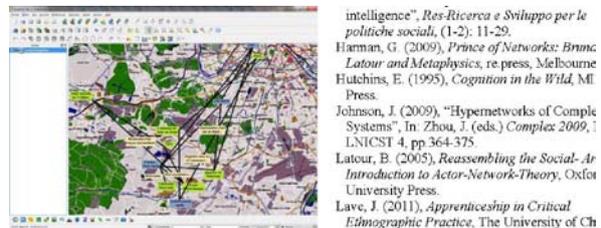

Figure 6: Projection of an extract of the territorial fitting of Cluster Paris-Saclay in the SIG Quantum.

5. CONCLUSION

This approach clearly presents mathematical intuitions. It relies on a strong principle of connectivity. The simplicial formalism is a rich and expressive formalism, which is a prerequisite for its use in the context of territorial, city or cluster modeling and simulation, in territorial intelligence perspective. Thus, we hypothesize that the simplical complex technique allows the representation of space as heterogeneous network. As a counterpart, assemblage theory is an alternative to the semantic (Lévy, 2009) or only cognitive, technological or informational approaches of the territorial intelligence.

References

Atkin, R., (1977) *Combinatorial Connectivities in Social Systems*. Basel, Birkhäuser Verlag.

Badiou, A. (2005), *Being and Event*, Olivier Felham, New York, Continuum.

Bourdieu, P. (1977), *Outline of a Theory of Practice*, Cambridge University Press.

Çalışkan, K, Callon, M. (2010), 'Economization, part 2: a research programme for the study of markets', Economy and Society, vol. 39, no. 1, pp. 1-32.

DeLanda, M. (2006), *A New Philosophy of Society: assemblage theory and social complexity*, Londres ; New York : Continuum.

Deleuze, G. and Parnet (2002), C., *Dialogues*, Columbia University Press.

Foucault, M. (1980), *Power/Knowledge: Selected Interviews and Other Writing*, 1972-1977, ed. C. Cordon, New York: pantheon Books,

Giddens, A. (1979) *Central problems in Social Theory*: Action, Structure and Contradiction in Social Analysis, London, Macmillan.

Girardot, J-J., (2009). "Evolution of the concept of territorial intelligence within the coordination action of the European network of territorial intelligence", *Res-Ricerca e Sviluppo per le politiche sociali*, (1-2): 11-29.

Harman, G. (2009), *Prince of Networks: Bruno Latour and Metaphysics*, re.press, Melbourne

Hutchins, E. (1995), *Cognition in the Wild*, MIT Press.

Johnson, J. (2009), "Hypernetworks of Complex Systems", In: Zhou, J. (eds.) *Complex 2009*, Part I, LNICST 4, pp.364-375.

Latour, B. (2005), *Reassembling the Social- An Introduction to Actor-Network-Theory*, Oxford University Press.

Lave, J. (2011), *Apprenticeship in Critical Ethnographic Practice*, The University of Chicago Press.

Legrand, J. (2002), "How far can Q-analysis go into social systems understanding?" *5th Systems Science European Congress*.

Marston, S.A., J.P. Jones, III, and K. Woodward. 2005. "Human Geography without Scale," Transactions of the Institute of British Geographers 30(4): 416-32. Reprinted in *Theory and Methods: Critical Essays in Human Geography*, C. Philo, ed. Hampshire: Ashgate

Meillassoux, Q. (2008), *After Finitude: An Essay on the Necessity of Contingency*, New York, Continuum, Tra edition.

Rescher, N. (2001), *Process Philosophy: A Survey of Basic Issues*, University of Pittsburg Press.

Schatzki, T., Cetina, K. K. & Von Savigny, E. (Eds.). *The practice turn in contemporary theory*, London: Routledge.

Schatzki, T.R. (2002), *The site of the social: A philosophical account of the constitution of social life and change*, University Park, PA: Pennsylvania State University Press.

Sloterdijk, P. (2011), *Bubbles: Spheres* Volume I: Microspherology, Semiotext(e).

Weick, Karl E. (2009), *Making Sense of the Organization: The Impermanent Organization*, John Wiley & Sons Ltd.

Žižek, S. (2006), *The Parallax View*, Cambridge, The MIT Press.