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**Project Collaboration in Science.
A research framework and an application
in a context of research policy evaluation**

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Abstract

Scientific Context

Without ignoring the existence of a large array of scientific perspectives about the measurement of science productions and science dynamics, we situate our work in the branch of analysis and visualization of social networks. This field - as well as indicators definition- has been an important step forward for the evaluation and policy of science (Callon et al., 1986; Law et al., 1988). Within this tradition of analyzing free-associations in relation to Actor-Network-Theory, the understanding of scientific collaborations had supposed consequent methodological and ethical requirement. This is still very much at stake today in a momentum when the data about scientific activities are continually growing, while the heterogeneity of scientific activities is still important despite many attend to rationalize, measure and evaluate its quality and performativity. Besides the necessity of evaluating the performance of normal science and technological creativity, there are many signs of an on-going critical self-evaluation of the reliability of science indicators (Barré, 2001; Freeman Soete, 2008). In this trend, characterizing and mapping collaboration appears to become a compulsory instrument both for scholars and decision makers, but also for researchers (Noyons, 2001; Heimerik et al., 2003; Van Den Besselaar et al., 2006).

This situation still echoes what Zitt and Bassecoular (2008) had identified under three main challenges for scientometrics and for the relations between those who study science and technology production and those who create knowledge and techniques: (1) the quality of accountability of knowledge dynamics within various source of data, (2) the necessity to characterize dynamics as well as evaluating positions and (3) the common problem of diversity. In our view the interplay of those challenges, evoked almost 10 years ago, points the need to encourage characterization of knowledge and technological dynamics at the heart of the sociability of scientific activities, says

research collaboration. We would like to follow here Beaver's recommendation, which proposed to consider collaboration in research as « *standing somewhere between the context of discovery and the context of justification* » (Beaver, 2004, p. 402). Since, the nexus of those collaborations are taking place in research projects most of time, the node of this area of enquiry remains the funded research project.

State of the art

Within this evolution of research activities projectification, Bozeman and Rogers (2002) had issued a very contending claim towards a culture of counting outputs, when they have called that research evaluation should take into account the social configurations through which new scientific and technical knowledge is produced. Following their anchorage in a tradition focusing on laboratory life or laboratory profile and R&D programme they have claimed that "*many scientists do not conceptualize their work in terms of funding source or the project account and, instead, view project as chiefly a bureaucratic artifice*", *ibid*, p.771). Their conceptual model (the churn model) reflects their strategic approach of interactions between researchers and thus they distinguish between "*projects that exists in the mind of bureaucrats*" and "*knowledge communities that exist as human interactions with information*", *ibid*, p.392.

But, nowadays, the evolution of the analysis of scientific networks is particularly attached to the question of characterizing collaborative and cognitive dynamics of knowledge production, and the study of collaboration networks through projects database seems to be more active (Boardman and Colery, 2008; Karlovcec and Mladenec, 2015; Ma et al., 2015). Bammer (2008) has highlighted some of the key challenges of this area of investigation, in order to provide frameworks for assessing the integration of different perspectives about scientific collaboration. This perspective goes beyond some of the foundational works about collaboration: Wagner and Leydesdorff (2005) about the pattern of collaboration networks, Bozeman and Corley (2004) or Katz and Martin (1997) about the motivation for collaborations and its measurement; Rigby and Edler (2005) about the conditions of success; Bozeman and Rogers (2002) about strategic behaviors of researchers or Roediger-Schluga and Barber (2006) about R&D collaboration in the European FPs.

Object of enquiry

At the stage of development of our work on projects collaborations, we intend to challenge this model suggesting that even though such a divide between the realm of bureaucrats and Knowledge Value Collective would exist, the strategic use of project collaborations remains a matter of enquiry. This may particularly be the case if one follows the fact that R&D or Research program policy is particularly open to researchers and scientific experts (because of ex-ante evaluation with peer-reviewing of proposals) or to lobbying pressure of visible or invisible colleges. All this is more or less related to science dynamics and to researchers at work, not only to bureaucrats, and very often to boundary organizations (Guston 2001). Thus, in order to consider this dimension of boundary work at the frontier of funding agency or national program committees, it seems relevant to characterize project collaborations as a heuristic. In our view, a project is a boundary loosely coupled organization that represents a scientific promise and a justification of capabilities, which are carried by a bunch of colleagues. After decades of measurement of science, the research project seems not to have received

enough attention, and perhaps because of the taking-for-granted framework about projects being considered as elements of bureaucracy and not science.

Research Framework

Tracing and mapping knowledge in scientific database or in other electronic sources still represents a huge field of problems for many disciplines dealing with information extraction. More locally, in relation to specific area of research, mapping heterogeneous networks appears to help the understanding of social dynamic of research activities (Cambrosio, Keating, Mogoutov, 2004; Cambrosio et al., 2006; Bourret et al., 2006). Thus, the nature of collaborative relationships is to be questioned in accordance to the reality of practices of collaborations. We would like to raise the contention that the focus on co-authorship and citation measurement has perhaps blurred our understanding of collaborations in science and technology, since publication of articles and patents is certainly a sign of knowledge dynamic but not necessarily THE only dimension of normal science and technology. Our communication would like then to focus on collaboration at the level of research project, not considering those collaborations in a pure communication theory perspective but as collaborations existing within a social world of science and technology. Our research is attached to a specific context that precisely reveals the need for Research Agency and Funding Program to learn from their effect on a specific research domain.

We have conducted a research within the French Research Agency about 10 years of funding in the area of agricultural and environmental research, thanks to three national calls for projects. Being embedded at the heart of the Agency we could develop a fine approach of data, and be active in the remediation of database about projects and almost have access to precious information: submitted projects. Our empirical works relays on the building of a database of more than 330 submitted projects and 93 being selected for a total of 54 Millions euros. This database covers more than 350 labs or research teams.

We wanted to question research dynamics through a large scope of sources related to research programs. Within those programs, the RD project is our unit. The variety of organizational features lead us to conduct systematic data mining, data extraction and to constitute an adequate and robust information structure through the creation of a heterogeneous and relational database. Project properties, specifications concerning researchers, laboratories and institutions, as well as network indicators have been informed as precisely as possible. The originality of our empirical work relays on information extraction at the level of Abstracts that have received a textual content analysis based on co-occurrence of N-grams. The evolution of the lexical texture of project description and collaboration network is visualized thanks to community detection algorithm. The use of specific tools to index database and visualize networks in the context of characterizing emerging domain of collaborations within Research and R&D projects represents a significant step forward to develop the field of scientometrics towards the characterization of S&T Dynamic. It also enables to open the field of design of methodology and visualizing solution to enhance new ways of tacking with relational data. This attitude toward methodological equipment for the visualization of cowords clusters and mapping shares many ideas of shifting from a scientific context to a science policy context (Noyons, 2001).

Results

We have thus realized the interpretation of co-word maps with the Evaluation committee appointed by ANR to deliver a retrospective account about the effect of those three programmes. Our study has thus contributed to the elaboration of an ANR Report (ANR, 2015). Our work also took part in a strategic discussion about the use and impact of thematic programme in relation to on going research policy evolutions in France. This contribution and the final report (Barbier & Breucker, 2015) have been published by the Agency, which represents a direct contribution to Research policy evaluation.

Our communication will start with a discussion about a necessary revival of project collaborations studies based on an integrated approached of database crossing institutional fields and more textual contents. Then we will present our methodology and the context of action within the French National Research Agency. We will then after present a characterization of the evolution of the textuality of projects through time in relation to the constitutive network of collaborations in between teams. We will finally discuss about the co-evolution between the research programmes incentives and of the ecology of collaboration networks of Laboratories.

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