Social Network Analysis and the Study of University Industry Relations

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INTRODUCTION

The methodological approach of Social Network Analysis (from now on, abbreviated SNA) can bring many benefits for the study of university and industry relations (from now on, abbreviated UIR). Relations between university and industry are important in innovation studies because they can be considered as an innovation network, in the sense that the interactions established by their participants have more or less defined innovation goals (Mansfield & Lee, 1996). SNA is the study of social structure (Wellman & Berkowitz, 1988). It describes a group of quantitative methods for analysing the ties among social entities and their implications (Wasserman & Faust, 2007). With the use of SNA it is possible to explore and to better understand different innovation outcomes involving UIR, by analysing the different measures and the structure of the social network. In this work the SNA methodological approach is described and its fundamental concepts are presented. The paper then reviews the applications of this approach on the study of the relationships between university and industry. The paper aims at systematizing the available information and knowledge, highlighting the main research pathways, the main conclusions and pointing possible future research questions.

BACKGROUND

UIR is an increasingly important and researched phenomena. Theoretically and structurally, the theme is linked to the study of the innovation process and to the need of understanding it and in-fluencing it. Linear perspectives of the innovation process placed the university at the beginning of a linear sequence of innovation and the firm at the end of it, largely ignoring the interaction between the two types of institutions. New, interactive, dynamic, complex perspectives see the innovation process as a system involving many institutional actors, as a network of relations and as a complicated web of knowledge exchange and utilization. Science and technology are increasingly complex and costly and no single actor commands the necessary resources, relying on multiple sources of information and knowledge exchanges that are crucial for a successful innovation process. In this context, and considering the many types of relations and actors that may be possible in the innovation process, the relationships between academia and industry stand out as particularly relevant, because of the type of institutions that participate and the nature of the information and knowledge that is exchanged. The literature on UIR has raised many issues on the theme, and debates are ongoing, which can be found in some review articles (Baldwin & Green, 1984; D'Este & Patel, 2007; Perkmann et al., 2013). Only some of the issues and debates will be explored here, namely those researched by SNA concepts. They will be referred in more detail in the following section, along with the presentation of the results of the literature review, which is the main focus of this work.

SNA is the study of social structure using a group of quantitative methods. It analyses ties among social entities and looks for key players and group patterns. SNA uses concepts that are related to the structural properties of the network

and indicators that are related to relational properties of the network. The most used concepts related to structural properties of the network in UIR studies are the concepts of density, component, and subgroups. The most used social network analysis concepts related to relational properties of the network are the concepts of degree centrality, betweenness centrality and geodesic distance.

The concepts related to structural properties of the network are basic and important concepts that characterize the overall structure of the network. Through the concept of density (which indicates the level of connection between all the nodes of the network) it characterizes its global cohesion. Through the concept of component (which indicates the existence of large groups inside the network) and through the concepts of subgroups or cliques (which indicates the existence of smaller, cohesive, specifically defined groups) it characterizes its internal structure. The combination of these indicators and an adequate interpretation of their meaning provides useful descriptions and characterizations of the network, in terms of the position of their nodes and constituents. The characterization is frequently complemented with visual aids, namely through sociograms. Sociograms are diagrams composed of nodes and lines. The nodes are the actors of the network and the lines are the connections between the actors. The concepts related to relational properties of the network are often at the centre of the analytic procedure, and are used in several ways according to specific research objectives. The concept of degree centrality (which indicates the extent of a node connection) identifies the most connected actors. The concept of betweenness centrality (which captures the intermediary nature of a particular node's connection) is used to identify and characterize the intermediary positions of actors in the network. Besides the main concepts referred above, other concepts related to these ones are also used, but less often. All these concepts are mathematically defined, but it is beyond the scope of this paper to provide detailed algebraic specifications, which are available in several books (Scott, 2000; Wasserman & Faust, 2007).

THE LITERATURE REVIEW

General Aspects and a Synthesis of the Main Results

There is not a great number of articles that addresses specifically the problem of UIR using SNA techniques. There is a variety of perspectives that reflect specific and idiosyncratic concerns of the authors. Few papers follow the same guidelines or share identical perspectives. However, there are small groups of authors that build on past works or use identical databases, such as patent databases.

In terms of the main study object or main research preoccupation the studies can be classified in the following categories: 1) the study of the characteristics of personnel/institutional networks that are prominent in university-industry relations; these studies generally rely on the use of patents that are co-produced jointly by university and non-university members, and the patterns of collaboration are analysed; 2) the study of university-industry relations in the context of specific industrial settings or in the context of specific institutional conditions; these studies may rely also on patent databases but other types of data may be used, either primary data, obtained through questionnaires, or secondary data, obtained through diverse documental sources; 3) the contribution of the study of university-industry relations to the validation of theories; these studies also rely on a mix of patent, primary and secondary data.

In addition to these themes there are other themes that are addressed in these studies, either in a parallel way or as themes that frame the former or the research approach. The themes that could be common to the papers are, in broad terms, the three main themes above indicated but, within each one, the approach and main research concerns and targets are quite different. The literature will be analysed not through the lens of the broad themes, but through the details of the specific papers. This methodology will permit to extract from the papers the main academic debates and to highlight the respective contributions to

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