

# Regional Knowledge Maps

## *Potentials and Challenges*

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**Keywords:** Knowledge Maps, Regional Development, Text Mining, Regional Policy.

**Abstract:** Regional knowledge map is a tool recently demanded by some actors in an institutional level to help regional policy and innovation in a territory. Besides, knowledge maps facilitate the interaction between the actors of a territory and the collective learning. This paper reports the work in progress of a research project which objective is to define a methodology to efficiently design territorial knowledge maps, by extracting information of big volumes of data contained in diverse sources of information related to a region. Knowledge maps facilitate management of the intellectual capital in organisations. This paper investigates the value to apply this tool to a territorial region to manage the structures, infrastructures and the resources to enable regional innovation and regional development. Their design involves the identification of information sources that are required to find which knowledge is located in a territory, which actors are involved in innovation, and which is the context to develop this innovation (structures, infrastructures, resources and social capital). This paper summarizes the theoretical background and framework for the design of a methodology for the construction of knowledge maps, and gives an overview of the main challenges for the design of regional knowledge maps.

## 1 INTRODUCTION

In the present paper we investigate the value of knowledge management if it is applied to geographic regions. Especially we focus on the role of regional knowledge maps for regional innovation management. We argue that more research is needed in this area in order to collect, structure and make efficient use of the vast amount of mostly textual and unstructured information that is available for almost every region in industrial countries.

In the first place, knowledge management (KM) provides a framework to identify which knowledge is created or needed in the different organizational processes, and how it can be created and stored to generate value in an organization (Raghu and Vinze, 2007); (CEN, 2004). In this context, knowledge maps play an important role.

Applied to the territories, knowledge management identifies how the knowledge cycle works in a territory, and it is considered a way to the regional innovation, important in an economy based on knowledge and innovation (Asheim and Coenen,

2005); (OECD, 1996); (Lundvall, 1992). In this sense, recently, some authors have pointed out knowledge maps as an instrument to manage knowledge in a territory and to promote its development (Barinani et al., 2013, España, 2011).

Secondly, KM as discipline for years has developed research about the role and value of knowledge maps, but offers little research about how to do it, and how to create regional knowledge maps (Wathananon and Mingkhwan, 2012); (Driessen et al., 2007); (Huijsen et al. 2004); (Kim et al., 2003); (Eppler, 2001); (Wexler, 2001). More concretely, regional knowledge maps could collect the territorial knowledge created by the different actors involved in a region (authorities, clusters, companies, universities, NGO, etc.). They could also collect the information's fluxes between these actors. Their analysis contributes to identify the strengths and weaknesses at national or regional level, to produce new insight capabilities for regional stakeholders (industry, academia, and civil society) regards identifying new areas of applied research, how to promote industrial leadership in a region, and how to coordinate and integrate research agendas and

actions. Consequently, they could help in a local way the decision-making needed for a consistent implementation of regional policy coordination in order to optimize resources.

Hence, building territorial knowledge maps to support innovation and regional development represents a major step forward, due to the complexity of aspects that these maps should collect: which processes take place in a territory, which knowledge is created or needed in the different processes, how and where can knowledge be created and stored, which structures and infrastructures exist in a region related to knowledge and innovation, and the information fluxes among its actors.

This paper reports on work in progress on the design of a methodology to develop territorial knowledge maps as a tool for regional development.

The remainder of this paper is structured in four parts. Firstly, we specify the objectives and the research questions. Secondly, we expose shortly the theoretical backgrounds used as basis to develop the theoretical framework. Thirdly, we describe the challenges faced to build knowledge maps. Finally, we present the conclusions.

## 2 OBJECTIVES AND RESEARCH QUESTIONS

Our objective is defining a methodology to efficiently design territorial knowledge maps, by extracting information of big volumes of data contained in diverse sources of information related to the territory. The methodology, of course, should be independent of the specific.

Consequently, the work implies facing several challenges, which we have concretised in the following objective: knowing how we can extract knowledge from a wide amount of sources related to one region and visualize it to get a complete picture of the region's innovation potential. To conceptualize how to do so is the case for the project in process presented in this paper which turn on the following research questions:

1. Which information sources help to find this knowledge?
2. Which are the territory's actors involved in innovation?
3. How can we identify the knowledge available in a certain region?
4. How can we study the social relationships, conventions, norms and rules that influence innovation?

5. How can we mine the territorial data to create knowledge maps that enable stakeholders to apply them for innovation and regional development?
6. How can we identify innovation potentials that remain hidden and unobserved until now?
7. How can we identify obstacles hindering innovation?

The first four questions are directly related to the project's objective, because they point out to which methodology is adequate to build knowledge maps. The last two are oriented to detect which knowledge is important to be incorporated in a regional knowledge map to assure the focus on innovation.

## 3 THEORETICAL BACKGROUND

Taking into account the aims mentioned above, our research is based on four perspectives, each of which has its own corpus of knowledge. These perspectives are: knowledge management, competitive and territorial intelligence, Regional Innovation Systems, and text mining.

*Knowledge Management (KM)* is a methodology that integrates the activities embedded in the organizational processes to obtain organisational aims and manage intellectual capital (Raghu and Vinze, 2007; Ergazakis et al., 2005; CEN, 2004; Bolinger and Smith, 2001; Beijerse, 1999). KM applied to private or public organizations and to the territory contributes to generate competitive advantages (Danskin et al., 2005).

*Competitive Intelligence (CI)* until the present has developed a framework to manage strategic information oriented to generate intelligence in the organisations scale, but in the territory scale studies are incipient and are named *Territorial intelligence (TI)*. This framework is based on a cycle, which considers the following phases: identification of information's needs, its acquisition, its organisation, its analysis, and knowledge/intelligence creation (CAENTI, 2012); (Garcia-Alsina and Ortoll, 2012).

*Text mining and analytics* offers the tools to exploit the wide quantity of unstructured data to extract information, which once analysed becomes information and knowledge. Text mining enables the automatic analysis of large amounts of text from the internet (companies, institutes, governments, etc.) (Kosala and Blockeel, 2000); (Moens (ed.), 2006). Using techniques like *named entity recognition* (Nadeau and Sekine, 2007) and topic detection

(Wartena and Brussee, 2008) it is possible to find the main (innovative) products an industry in a region is working on, and not only its existing relations, but the missing relations, too. Text mining is used for business intelligence, for KM within companies and for studying customer behaviour and satisfaction (Saggion et al., 2007), and to monitor new developments in a certain field of technology (Färber and Rettinger, 2013). Text mining is also used to find experts and networks of experts (Ehrlich et al., 2007). The application of text mining to regional intelligence to systematically mine the expertise and innovative potentials of all companies in a region is new and will have to deal with a host of challenges concerning the interaction of crawling and analysing web content

Finally, *National or Regional Innovation Systems (NIS or RIS)* offer the framework to identify which kind of actors, resources, social capital, structures, institutions and organizations are involved in the diffusion of new technologies and infrastructures in a geographical area to support innovation and regional development (Andersson, 2013); (Chen and Guan, 2011); (Jimenez et al., 2011); (Sharif, 2006); (Doloreux and Parto, 2005); (Asheim and Coenen, 2005); (Cooke, 2001); (Cooke et al., 1997); (Edquist, 1997).

More concretely, our theoretical framework deals with the following topics, which can lead or promote innovation and development in a region (Fig. 1).

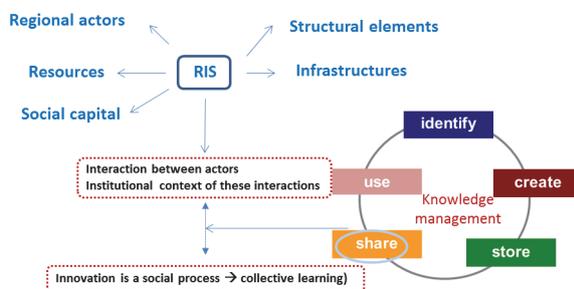


Figure 1: Parts of a regional innovation system.

Firstly, we must to identify which are the *regional actors* in a region, who has been identified in previous studies: higher institutions, public and private sectors and social spheres (Jimenez et al., 2011); (Fröhlich, 2010); (Sharif, 2006); (Voß et al., 2002). The second element to study is the *structural elements* related to economy (kind of sectors or firms' size), knowledge (disciplines, institutions) Politic and Administration (parties, parliament, local government, and associations) (Fröhlich, 2010); (Voß et al., 2002). Thirdly we focus on infrastructures: technic (water, wastewater, energy

and transport), social (health, education, culture), finance (banking sector, venture capital and government aid), policies, and science and innovation systems (Voß et al., 2002); (Edquist, 1997). The next element to be considered is the resources existing in a territory, those related to the Nature (geology, water, air, climate, accumulations capacity), row material (minerals, vegetarian, animal), demography (inhabitants, structure), regional innovative capabilities and intangible assets (intellectual capital) (Doloreux and Parto, 2005); (Voß et al., 2002) Lastly, as innovation is a social process through which organizations learn (Doloreux and Parto, 2005), we incorporate the framework of social capital as an element to be considered in the knowledge map. Social capital refers to which social relationships and in which context take place to generate knowledge as basis to innovation. More concretely, this framework gives insights about which are the institutional collaboration (universities – government – industry) (Etzkowitz and Leydedorff, 1995), and the different dimensions that could influence the social capital: structural dimension (networks ties, network configuration, and appropriable organization); cognitive dimension (shared codes and languages, shared narratives); and relational dimensions (trust, norms, obligations identification) (Nahapiet and Ghoshal, 1998).

## 4 CHALLENGES

When trying to build a regional knowledge map we face a number of difficulties. The most important problems are 1) the lack of clear definition of regional knowledge maps and a methodology for their development, and 2) the wide variety of topics to be considered, which require identifying the adequate information sources, dealing with different kinds of formats and structures, and different methods to design the data collection, sampling, and data analysis. Other challenges are consequence of these central problems. We find challenges in the following areas: a) methodology to build knowledge maps, b) identifying elements from a RIS (actors, structures, infrastructures and resources) and their information sources, c) discovering social capital and social networks in the region between actors, and d) analysis process.

### 4.1 Methodology

The few works dedicated to knowledge maps have

developed techniques oriented to: a) capture explicit and tacit knowledge, b) analyse knowledge areas in organizations, c) identify through which organization's information sources, the organizational knowledge can be captured, d) and to illustrate how knowledge flows throughout an organization (Kim et al., 2003). Nevertheless, the typology of the sources to consider, and the actors and processes developed in an organization are different in this works from those studied in regional studies. Thus, new ways to develop knowledge maps must be explored. Besides, the methods used to collect and extract information to draw knowledge maps often are qualitative.

## 4.2 Identifying Elements from a RIS

Identifying the elements included in a RIS and their sources is another challenge to this project. On the one hand side, the vast amount of actors in a reasonable region that can easily exceed the number of 100,000, and the diversity of the information sources, make it to a real challenge to achieve completeness and an equable granularity of information. Especially those actors that are either very small, very new or not well connected in networks and/or the Web will be difficult to identify. The same happens with structures and institutions, because they are different between regions, and also they could lack presence on Internet. Moreover, there are hardly any lists available of all actors in a region. Since websites of companies not necessarily link to other companies in the same region, crawling the web by following links is not an efficient option. Thus information hubs for a region have to be found that link to, or mention the most important actors in a region. These information hubs might serve as a starting point for crawling information. Potential information hubs include chambers of commerce, business associations, business networks etc. Also printed lists from such organizations and from local governments constitute useful sources of information.

More fundamentally, we have to define what the actors in a region are. Companies and organizations are structured across borders of regions. Companies might be present in a region but only with a small part of their activities. It can be very hard to identify the role a company plays in a region. Public available sources of information are not designed to reveal these structures, but are usually consumer oriented and give only addresses of headquarters and sales offices. Finally, each region has a lot of actors that might be uninteresting for a knowledge map for

regional innovation. Each village will have a bakery, a plumber etc. that are uninteresting for the final picture of the innovative potentials of a region. Nevertheless, also a bakery or a plumber can be an innovative company and advance to an important regional or supra regional actor. Thus the decision, which actors to include in a regional knowledge map and which not, is a further challenge.

The identification of social capital and social networks between actors and their influence in innovation process is another challenge. However, this discipline in the last years has advanced and methodologies and software tools for social network analysis have become available.

## 4.3 Analysis

Finally, during the analysing process the text and link mining procedures (Lieberam-Schmidt, 2010) have as challenge to find the right tradeoff between manually performed work and machine based automatism. While manual work may achieve higher quality of results, only automated text mining methods will be able to process the vast amount of information sources. Using information crawled from websites of companies, preliminary results show that it is feasible to find addresses, phone numbers, etc. by named entity detection on the crawled texts. For this purpose regular expressions for these entities were defined and the number of occurrences of entities on the web pages is counted. The most frequently found address and phone number usually indeed present the company's main contact information. Also, we have very encouraging results with respect to the classification of the main activity of a company using their Web presence. For this purpose we used the main economic sectors of the STW Thesaurus for Economics (Gastmeyer 1998); (Neubert 2009).

On the other hand it turns out to be much more challenging to find relations between companies or to find products or services made by a company. The main problem is the diversity of the resources and of the type of actors. Again a clear definition of actors and a missing correspondence between actors and information resources poses a major problem. Large companies and institutions, like universities, cannot be seen as single actors that have one main activity. Rather we have a complex and partly obscure hierarchy of actors for which it is already difficult to identify at which level in the hierarchy the activities should be classified.

## 5 CONCLUSIONS

The design of regional knowledge maps emerges as an important topic of research because their content could enable the strategic planning and decision-making process in regional policy. Regional knowledge maps could also enable the relations between actors and the collective learning as a basis to the innovation.

Their design requires capturing all the information about the regional competencies composed by infrastructures, structures, resources, actors, knowledge and social capital. The collection and the representation of these elements present a number of challenges that must be resolved.

The challenges could be faced with the conjunction of different disciplines to define a methodology. The theoretical corpus of knowledge management as discipline offers a basis to develop this methodology, so in the future this topic could be one more to be considered with the alliance of other areas of research: text mining, regional innovation systems and competitive and territorial intelligence.

This paper has the will to help starting this new line of research. The challenges presented are the result of the first phase of an exploratory research project. On the one hand the project focuses on the identification of information sources related to a region, from which we extract information as a first approach to the objective. On the other hand we identify which tools facilitate extracting information of these sources, according to the theoretical framework designed. During this phase we delimit the search to some specific elements of the RIS in a small geographical area, concretely the region of Hanover (Germany). Finally, we will validate this methodology applying that to other regions.

## ACKNOWLEDGEMENTS

This research is funded by the Spanish Ministry of Education, Culture and Sport (Ref. CAS 12/00155). The Catalan Government's Commissioner for Universities and Research supports the KIMO research group on knowledge and information management in organisations.

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