

Using Text Mining Tools to Define Territorial Competitiveness Indicators

David Ovallos-Gazabon¹, Nataly Puello-Pereira², Farid Meléndez-Pertuz², Jaime Vélez-Zapata², Emiro De-La-Hoz-Franco², Joaquín F. Sanchez³, Claudia Caro-Ruiz³, César A. Cárdenas³, and Carlos Collazos-Morales³

¹ Vicerrectoría de Investigaciones, Universidad Simon Bolívar, Barranquilla, Colombia

² Universidad de la Costa, Barranquilla, Colombia

³ Vicerrectoria de Investigaciones, Universidad Manuela Beltrán, Bogotá, Colombia.

david.ovallos@unisimonbolivar.edu.co

Abstract. For this study, articles from the fields of Social Sciences; Economics; Econometrics and Finance; Business and Management; and Accounting have been monitored for the period from 1979 to 2017. VOSviewer® was used to create, visualize and explore bibliometric information from Scopus scientific database, for the identification and definition of territorial competitiveness indicators. It has generated preliminary conclusions using citation relationships between journals, collaborative relationships between researchers, and coexistence relationships between scientific terms from the identified target literature.

Keywords: Text Mining, Vosviewer, Competitiveness Measurement, Indicator, Territorial.

1 Introduction

The functionality of text mining tools provides support for creating term maps based on a corpus of documents. A term map is a two-dimensional map in which terms are located in such a way that the distance between two terms can be interpreted as an indication of the relatedness of those terms. In general, the smaller the distance between two terms, the stronger the terms are related to each other. The relatedness of terms is determined based on co-occurrences in documents. These documents can be for instance scientific publications (either titles and abstracts or full texts), patents, or newspaper articles [1].

Territorial competitiveness is defined on the types of legitimate spatial delimitations established by the current society, and their convergence in the global space, influencing the strategic positioning of their economies through the use of capital, territorial resources, and institutional agents [2], [3]. In addition, it seeks to increasingly integrate all activity sectors promoting a global coherence with the cooperation

of all territories, and articulating policies oriented to the social, productive and economic growth in each territorial space [4], [5].

Measures of territorial competitiveness are relevant tools for identifying and analysing current problems, establishing effective strategies for territorial improvement and life quality population [6]–[8]. However, there is no a consensus about which indicators should be used for this purpose, on account of the diversity of existing models and of the analysis context that may be country, regional, urban centres and rural areas.

The main indicators of territorial competitiveness develop the quantification of current economic, political and social conditions [9]. A literature review indicates that the smaller the territory, more specific are its measurements towards the sectors of the territory that have lower levels of competitiveness. It is found measurement levels of global, macro, meso, national and rural type [3], [10]–[13].

Using VOSviewer® [14]–[17], it is an initial exercise to identify territorial competitiveness indicators that can be implemented in the municipal context, and that are aligned to indicators systems currently used in the Colombian context in order to strengthen its policies of technological innovation, and productive growth, envisaging to be more internationally competitive [18]–[22].

2 Methodology

In this study, the worldwide scientific production about territorial competitiveness indicators is analysed using the information from 5233 articles identified in SCOPUS, built on the period from 1979 to 2017. The methodology pretends to identify certain trends in scientific production worldwide on the subject analysed; and from there, selecting recent or novel indicators that have not been frequently considered. Besides, it is important to define authors, institutions, journals and networks in order to ameliorate the analysis. The methodology of this work demands to minimize possible biases of the observer in the systematic review of literature on territorial competitiveness, and it consists of four phases.

2.1 Definition of guiding questions

The guiding questions have been defined as: What is territorial competitiveness? What are the main models and indicators for measuring competitiveness at the territorial level? Who are the most important authors, institutions and countries in the field? From these questions the search equation was developed and defined as:

TITLE-ABS-KEY (territorial AND competitiveness) AND (LIMIT-TO (SUBJAREA , "SOCIO") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA ,

"BUSI") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "MATH"))

2.2 Search in specialized databases

SCOPUS database was selected and the exploration generated 5233 records. SCOPUS compile results from other bibliographic databases and independent scientific publications.

2.3 Download of bibliographic records

once the records were identified, they were downloaded using the tools offers by SCOPUS. For this stage, the CSV format was used which facilitates its subsequent processing using EXCEL® 2016.

2.4 Consolidation and analysis of the information

It was used tools as dynamic tables and macros in EXCEL® 2016. It were created different tables and queries as Author vs Author, Country vs Country, Institutions vs Institutions, journals vs journals, and Keywords vs Keywords, among others. This process generates the input for the graphics elaboration in VOSviewer®.

3 Results

3.1 Countries Relationship

This visualization allows to identify three clusters, related to the origin of the publications country: Cluster number one, identified with green colour, has as core in the United Kingdom (UK) with roughly 1100 publications and the largest number of interactions, this is because some of the major journals and publishing companies related to this topic are based in the UK (Emerald Group Publishing, Blackwell Publishing Inc., Oxford University Press, SAGE Publications, among others). It is interesting to observe that main relationships in this cluster are between European countries, without implying a disconnection with other countries. See Fig. 1.

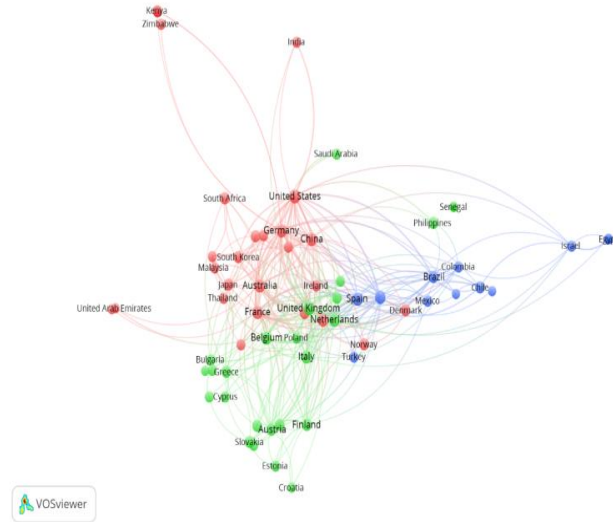


Fig. 1. Countries Relationship

The cluster number two, identified with red colour, has the United States as the country with the highest number of interactions along with Germany, China and the Netherlands; these countries are the location of some of the biggest publishing companies in the world (Taylor & Francis, Elsevier, Blackwell Publishing Inc., Springer, Routledge, among others). Cluster number three, underlined in blue colour, is mainly the group of countries with Latin languages which evidences the tendency to send works to publishing houses in the origin language (OmniaScience, Universia Holding, among others), but also includes countries like Egypt, Israel and Turkey.

3.2 Authors relationship

This visualization permits to identify the relationships between authors. Results are presented with authors with at least three works in conjunction with other authors from the list obtained. Besides, it is identified four clusters. On the whole, a high prevalence of authors with Asian origin is evidenced, being Zhang Y., and Wang Y. who develop more interaction or collaborations. An element to emphasize is that these authors are not in the group of authors or works most cited, according to the information identified in Scopus. See Figure. 2.

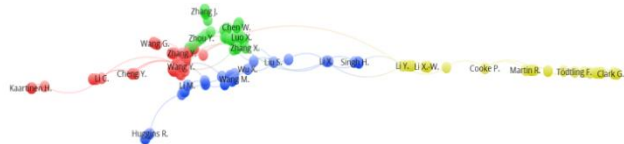


Fig. 2. Relations between authors

3.3 Relationship among institution

The liaison among institutions in the study topic it is shown in Figure 3. The cluster number one, in red colour, shows important levels of cooperation among universities in Hong Kong, Singapore, Lithuania, Italy (Polytechnic of Milan) and Spain (Polytechnic University from Valencia). The cluster number two, identified with green colour, has a predominance of Spanish institutions (Las Palmas Gran Canaria University, University of Malaga, Universidad Autónoma de Madrid, University of Barcelona), which shows cooperation at the country level; however, relations with other globally important institutions are evidenced such as Harvard University, Griffith University and University of New South Wales in Australia and have connections with Latin American universities such as the University of Sao Paulo and the Federal University of Viçosa in Brazil. See fig 3.

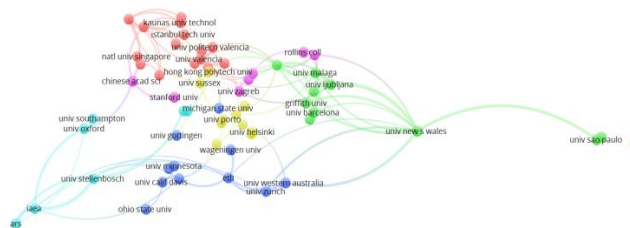


Fig. 3. Relationship between institutions

Cluster number three is identified with yellow colour and is composed mainly by North American universities with strong relations to other North American universities (University of Wisconsin, University of Illinois and University of Massachusetts) and a weaker relation with foreign institutions. Other institutions such as University of Porto, the University of Sussex and the Polytechnic University of Hong Kong stand out for generating interaction dynamics with other institutions worldwide. The cluster number four, distinguished with dark blue, has participation of universities and important non-university centres such as the United States Agricultural Research Service and cooperates with German institutions (University of Zurich, Federal University of Zurich) and other institutions in the Netherlands. The cluster number five, underlined in light blue, is defined by institutions such as the International Atomic Energy Agency (IAEA) and universities in the United Kingdom (Oxford and Southampton) which have important relationships with North American Universities (University of Michigan) and universities in South Africa (Stellenbosch University).

Co-occurrence of Keywords: Once the relationship between countries, authors and institutions have been identified, the relationship between keywords is studied. From this, it is identified the thematic areas or topics that will guide the definition of territorial competitiveness indicators. Besides, it is evidenced the existence of six interrelated clusters. The cluster number one, identified in red colour, contains elements associated with the effect of business agglomeration dynamics on competitiveness, positioning and local development. Other relevant elements in this group are innovation, knowledge economy, and territorial specialization. See figure 4.

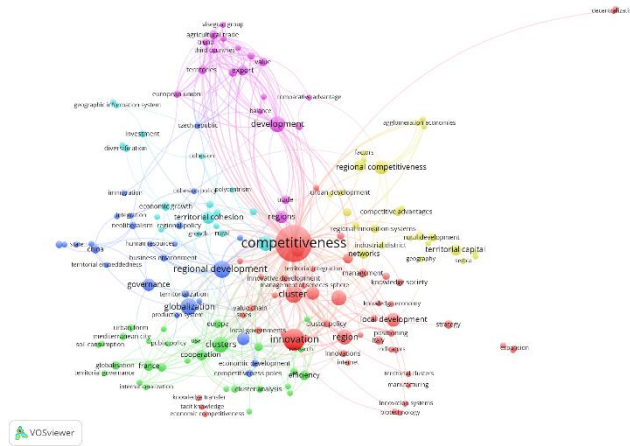


Fig. 4. Result for co-occurrence of keywords

The cluster number three, identified with yellow colour, is formed by elements related to the generation of competitive advantages and oriented to the urban and rural development through regional innovation systems and industrial districts. The cluster number three, identified with green colour, is mainly related to aspects of context analysis for competitiveness. The cluster number four, identified with dark blue, refers to elements or strategies of territorial specialization such as the development of a business environment, business empowerment, development of specialized production systems that are constituted in points of competitiveness and especially, the development of regional policies for the capacity improvement of human capital. The cluster number six, identified with light blue, contains elements related to economic growth through diversification, investment, territorial cohesion strategies and geographic information systems. Finally, the cluster six, underlined in purple colour, relates marketing elements at national and international level, highlighting the role of agriculture in this context.

3.4 Emerging areas for the definition of regional competitiveness indicators

An analysis of the terms found allows identifying emerging trends or concepts in the literature on territorial competitiveness. The existing models do not have a theoretical approach such as resources based view (RBV); moreover, not all models consider the firm performance as an element of analysis. Elements related to renewable energy, sustainability and energy are not common in the literature on territorial competitiveness. The exercise also evidenced the important role that has been taken in the analysis, the higher education to overcome barriers and build up a destination competitiveness to generate welfare. Other emerging terms are related to the role of tourism, the generation of efficient markets, the knowledge management, cross borders regions, and crisis. The Table I gives a summary of topics recognized.

Table 1. Topics Identified for construction of competitiveness indicators.

Topic	References
Renewable energy	[23]–[26]
Sustainability	[27]–[29]
Higher Education	[30]–[35]
Barriers	[36], [37]
Destination Competitiveness	[28], [38], [39]
Knowledge Management	[40]
Cross Borders Regions	[41]
Crisis	[42]–[45]
Driven Forces	[46]–[48]
Small and Medium-sized Entrepreneurship	[49], [50]

4 Conclusion

The use of text mining tools has proved to be a very useful technique in the identification of territorial competitiveness indicators. It was possible to recognize elements that have not been considered by other measurement models; thus, it is considered an important contribution in the development of indicators and instruments for the measurement of territorial competitiveness. Some of the main findings are related to resources based view (RBV) and the firm performance approach, as well as, to elements associated with renewable energy and sustainability.

Each element could be considered as a starting point for a new research in order to generate all necessary information to develop indicators of competitiveness in the territorial context. Competitiveness measure is an important tool that can determine those factors that influence in the growth of an economy in order to expand the opportunities for its populations; and in the Colombian context, it permit to strength its policies of technological innovation and productive growth.

References

1. N. J. van Eck and L. Waltman, "Text mining and visualization using VOSviewer," *ISSI Newsl.*, vol. 7, no. 3, pp. 50–54, 2011.
2. F. Fajnzylber, "Competitividad internacional: evolución y lecciones," *Rev. la CEPAL*, 1988.
3. M. E. Porter, "The Competitive Advantage of Nations," *Harv. Bus. Rev.*, 1990.
4. A. Smith, "The Wealth of Nations.," W. Strahan T. Cadell, 1776.
5. Chorianopoulos, T. Pagonis, S. Koukoulas, and S. Drymoniti, "Planning, competitiveness and sprawl in the Mediterranean city: The case of Athens," *Cities*, vol. 27, no. 4, pp. 249–259, 2010.

6. J. Fagerberg, "INTERNATIONAL COMPETITIVENESS *," vol. 98, no. 391, pp. 355–374, 2009.
7. Scott., "GLOBAL CITY REGIONS: TRENDS, THEORY, POLICY.," Oxford Univ. Press, 2001.
8. M. Mortimore., J. L. Bonifaz., and J. L. D. de Oliveira., "LA COMPETITIVIDAD INTERNACIONAL: UN CANÁLISIS DE LAS EXPERIENCIAS DE ASIA EN DESARROLLO Y AMÉRICA LATINA.," 1998.
9. M. De Guzmán and K. Rada Pantoja, *Indicadores de competitividad. Proyecto Andino de Competitividad*, 2001.
10. J. Lombana and S. Rozas Gutiérrez, "Marco analítico de la competitividad: Fundamentos para el estudio de la competitividad regional," *Pensam. y Gestión*, vol. 26, pp. 1–38, 2009.
11. world economic Forum., *The global competitiveness report 2015-2016*, vol. 5, no. 5. 2015.
12. S. Lall, "Competitiveness indices and developing countries: An economic evaluation of the global competitiveness report," *World Dev.*, vol. 29, no. 9, pp. 1501–1525, 2001.
13. M. Araoz, C. Carrillo, and S. van Gihhoven, *Indicadores de competitividad para los países andinos*. 2011.
14. N. J. van Eck and L. Waltman, *Measuring Scholarly Impact*, no. 1982. 2014.
15. D. Jeong and Y. Koo, "Analysis of Trend and Convergence for Science and Technology using the VOSviewer.," *Int. J. Contents*, vol. 12, no. 3, 2016.
16. N. J. Van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010.
17. Z. Zahedi and N. J. Van Eck, "Visualizing readership activity of Mendeley users using VOSviewer," in *altmetrics14: Expanding impacts and metrics, Workshop at Web Science -Conference, 2014*, pp. 23–26.
18. J. Barrios Vásquez and G. Angulo-Cuentas, "Prioritizing STI initiatives: towards a methodological framework," in *IAMOT 2016 - 25th International Association for Management of Technology Conference, Proceedings: Technology - Future Thinking, 2016*.
19. K. Schwab et al., *The Global Competitiveness Report*. 2014.
20. M. I. Velasques, *comision economica para america latinaa y el caribe.*, and *Departamento administrativo nacional de Estadistica.*, "Indicadores de competitividad y productividad para america latina y el caribe." p. 43, 1995.
21. Consejo Privado de Competitividad, "Informe nacional de competitividad 2015-2016," p. 271, 2015.
22. Consejo Privado de Competitividad., *Centro de pensamiento de Estrategias Competitivas.*, and *Universidsad Del Rosario.*, *Indice Departamental De competitividad 2015*. 2015.
23. S. . Roh and D. . Kim, "Evaluation of perceptions on economic feasibility of energy sources," *Energy Sources, Part B Econ. Plan. Policy*, pp. 1–4, 2017.
24. Mezósi, E. Kácsor, Á. Beöthy, Á. Töröcsik, and L. Szabó, "Modelling support policies and renewable energy sources deployment in the Hungarian district heating sector," *Energy Environ.*, vol. 28, no. 1–2, pp. 70–87, 2017.
25. M. Ligus, "An analysis of competitiveness and potential of renewable energy technologies in Poland," *Energy Environ.*, vol. 26, no. 8, pp. 1247–1269, 2015.
26. G. Caspary, "Gauging the future competitiveness of renewable energy in Colombia," *Energy Econ.*, vol. 31, no. 3, pp. 443–449, 2009.

27. Y. Tan, J. J. Ochoa, C. Langston, and L. Shen, "An empirical study on the relationship between sustainability performance and business competitiveness of international construction contractors," *J. Clean. Prod.*, vol. 93, pp. 273–278, 2015.
28. M. Cucculelli and G. Goffi, "Does sustainability enhance tourism destination competitiveness? Evidence from Italian Destinations of Excellence," *J. Clean. Prod.*, vol. 111, pp. 370–382, 2016.
29. T. Monfaredzadeh and U. Berardi, "Beneath the smart city: dichotomy between sustainability and competitiveness," *Int. J. Sustain. Build. Technol. Urban Dev.*, vol. 6, no. 3, pp. 140–156, 2015.
30. M. . Stonkiene, R. . Matkeviciene, and E. . Vaiginiene, "Evaluation of the national higher education system's competitiveness: Theoretical model," *Compet. Rev.*, vol. 26, no. 2, pp. 116–131, 2016.
31. S. . Lopez-Leyva and G. . Rhoades, "Country competitiveness relationship with higher education indicators," *J. Technol. Manag. Innov.*, vol. 11, no. 4, pp. 47–55, 2016.
32. L. Aleksejeva, "Country's competitiveness and sustainability: Higher education impact," *J. Secur. Sustain. Issues*, vol. 5, no. 3, pp. 355–363, 2016.
33. L. Svobodova, "Technological readiness and higher education in the Czech Republic," in *IEEE Global Engineering Education Conference, EDUCON, 2016*, vol. 10–13–Apri, pp. 874–882.
34. D. A. Ovallos-Gazabon, S. M. De La Hoz-Escorcía, and D. J. Maldonado-Perez, "Creatividad, innovación y emprendimiento en la formación de ingenieros en Colombia. Un estudio prospectivo," *Rev. Educ. en Ing.*, vol. 10, no. 19, pp. 90–104, 2015.
35. D. Ovallos Gazabón, B. Villalobos Toro, S. De La Hoz Escorcía, and D. Maldonado Perez, "Gamification for innovation management at organizational level. A state of the art review ," *Espacios*, vol. 37, no. 8, p. 2, 2016.
36. S. G. Kreneva, E. N. Halturina, I. M. Nurmhametov, and T. B. Bakhtina, "Forming estimation cluster structures from the point of view of competitiveness of potential of Republic Mary El with the influence of economic sanctions of the West," *Mediterr. J. Soc. Sci.*, vol. 6, no. 3, pp. 245–252, 2015.
37. "16th International Multidisciplinary Scientific GeoConference, SGEM 2016," in *International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM, 2016*, vol. 3, pp. 1–1100.
38. E. R. Cánovas and C. B. Castiñeira, "The role of the cultural heritage in the renovation of coastal tourism areas: The case study of the Costa Blanca tourism destination ," *Cuadernos Geograficos*, vol. 55, no. 2. Instituto Universitario de Investigaciones Turísticas, Universidad de Alicante, Spain, pp. 299–319, 2016.
39. P. Silvestrelli, "Tourism development through heritage enhancement and hospitality innovation," *Int. J. Glob. Small Bus.*, vol. 5, no. 1–2, pp. 20–33, 2013.
40. L. Rhéaume and M. Gardoni, "Strategy-making for innovation management and the development of corporate universities," *Int. J. Interact. Des. Manuf.*, vol. 10, no. 1, pp. 73–84, 2015.
41. T. D. Rutherford and J. Holmes, "(Small) Differences that (Still) Matter? Cross-Border Regions and Work Place Governance in the Southern Ontario and US Great Lakes Automotive Industry," *Reg. Stud.*, vol. 47, no. 1, pp. 116–127, 2013.
42. R. Capello, A. Caragliu, and U. Fratesi, "Modeling Regional Growth between Competitiveness and Austerity Measures: The MASST3 Model," *Int. Reg. Sci. Rev.*, vol. 40, no. 1, pp. 38–74, 2017.
43. R. Camagni and R. Capello, "Rationale and design of EU cohesion policies in a period of crisis," *Reg. Sci. Policy Pract.*, vol. 7, no. 1, pp. 25–47, 2015.

44. M. C. Sebastián, A. M. M. García, and F. G. López, "Europe 2020 Strategy and the Information Society as tools of cohesion and integration in time of crisis: utopia or reality?," *Investig. Bibl.*, vol. 28, no. 64, pp. 101–115, 2014.
45. S. De Rosa and L. Salvati, "Beyond a 'side street story'? Naples from spontaneous centrality to entropic polycentricism, towards a 'crisis city,'" *Cities*, vol. 51, pp. 74–83, 2016.
46. C. . Camisón and B. . Forés, "Is tourism firm competitiveness driven by different internal or external specific factors?: New empirical evidence from Spain," *Tour. Manag.*, vol. 48, pp. 477–499, 2015.
47. K. M. Thomé and J. J. Medeiros, "Drivers of successful international business strategy: Insights from the evolution of a trading company," *Int. J. Emerg. Mark.*, vol. 11, no. 1, pp. 89–110, 2016.
48. Patiño Builes, "Tendencias tecnológicas que influyen en el aumento de la productividad empresarial," *INGE CUC*, vol. 11, no. 2, pp. 84–96, 2015.
49. R. J. Arend, "Entrepreneurship and dynamic capabilities: How firm age and size affect the 'capability enhancement-SME performance' relationship," *Small Bus. Econ.*, vol. 42, no. 1, pp. 33–57, 2014.
50. Ericson, J. Holmqvist, J. Wenngren, H. Kaartinen, and W. D. Solvang, "SMEs' challenges and needs in relation to innovation agendas and strategies," in *2016 International Symposium on Small-Scale Intelligent Manufacturing Systems, SIMS 2016*, 2016, pp. 13–17.