International Journal of Latest Research in Humanities and Social Science (IJLRHSS)
Volume 05 - Issue 02, 2022
www.ijlrhss.com || PP. 89-96

Identification of Patterns in STI Public Policy Actors

Castro Yama Sonia
MsC. Economía, Especialista en Analítica de Datos

Torres Soler Luis Carlos
PhD. Pensamiento complejo, MsC. Ing. Sistemas, Matemático
Universidad El Bosque, Bogotá, Colombia

Tovar Galo Edmundo
Economista, Especialista en Políticas Públicas de CTI
Asesor Ministerio de Ciencia, Tecnología e Innovación

Abstract: Policymakers should identify leadership in public initiatives and, for that matter (Public Initiatives in STI). Taking the OECD's biannual STIP COMPASS survey, the information (qualitative and quantitative) is used to include it in software and perform a network analysis. Concerns are identified, among them, what rate of public entities present public initiatives in STI?, what are the most proposed initiatives for the public sector?, in which group of beneficiaries are the STI initiatives concentrated?, what is the evaluation rate of STI initiatives? This article has sections: the first, shows the determining factors and their methodology; the second, outlines the analysis of the data, its characterization and most relevant visualizations. At the end, conclusions and bibliographic references are presented.

Introduction

For decades, quantitative analysis have been carried out, generating different aids in descriptive statistics, in many cases it served to elaborate regional or national development programs, always aimed at a short, medium and long term horizon, but today analysis is carried out qualitatively and with qualitative data. This study takes initiatives in STI using networks to generate patterns. Perhaps it is a tool for structuring public policies. The algorithms in the software to generate networks make it easier to detect nodes with multiple interactions; therefore, these lines have the purpose of showing the use of networks so that organizations generate their plans (initiatives) with a constant development. It should be seen as a methodological proposal. The STIP COMPASS survey was taken on STI issues.

A network analysis is recreated to understand the processes of interaction and coordination in the systems (between state entities of Colombia, in the case of STI) or strategic alliances of different public entities. The qualitative approach distinguishes the way in which initiatives form hierarchies. It must be seen that the quantitative approach presents measures to identify the positions of the nodes (individuals, initiatives, programs, organizations) in the network. (Van Geenen, 2020)

For public policy makers, in addition to leadership, it is of great importance to have knowledge of how they develop, evaluate and impact the different organizations to which they are directed, that they propose or evaluate. Perhaps different tools can be used to perform an analysis; however, networks make it easier to know which clusters are formed, the interrelationships that are established and even the complexity of these in their development.

Metodología

Since 1993, the OECD has carried out the STIP COMPASS survey in more than 50 countries on initiative issues to monitor and analyze public policies in the areas of STI, different ministries and national agencies. This survey uses its data in software (Gephi program) with different algorithms to generate networks, It analyzed and indicate which are the foci or nodes of the initiatives of public agents. What can be found through networks leads to elaborate greater proposals when evaluating public policies, articulation between actors, having as head the Ministerio de Ciencia y Tecnología, which will be able to visualize more programs and be more effective.

The process starts with data mining; repeated initiatives are taken; each of the promoters of the initiatives is identified, this because they are unified in the STIP COMPASS survey.

Another factor is taken as the catalog of public entities, established by the General Accounting Office of the Nation; which determines that there are 330 institutions, where their participation has relevance as it is the

entity that brings together all the public entities characterized and subdivided (they are described in Table 1). With this catalog, a benchmarking is carried out between the entities reported in the survey and those registered in the Contaduría General de la Nación.

Table 1. Public Entities in Colombia by groups according to the Contaduría General de la Nación

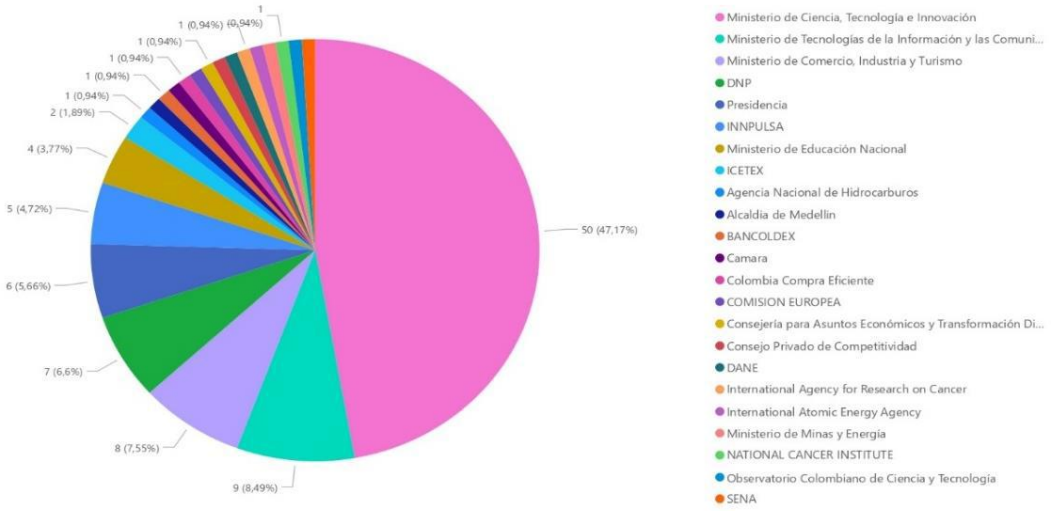
Tipo de entidades públicas	**Id Entidad**
Departamentos administrativos	6
Empresas de servicios públicos	19
Empresas industriales y comerciales del estado	11
Empresas sociales del estado	4
Establecimientos públicos	58
Institutos científicos o tecnológicos	10
Ministerios	18
Organismos de control	3
Organización electoral	1
Otras empresas	22
Otras entidades administración central	5
Otras entidades gobierno general	81
Procesos especiales empresas	1
Procesos especiales otras entidades	21
Rama legislativa	2
Rama judicial	2
Sociedades de economía mixta	16
Sociedades públicas	1
Superintendencias	10
Unidades administrativas especiales	39
Total general	**330**

Fuente: Contaduría General de la Nación.

Analysis

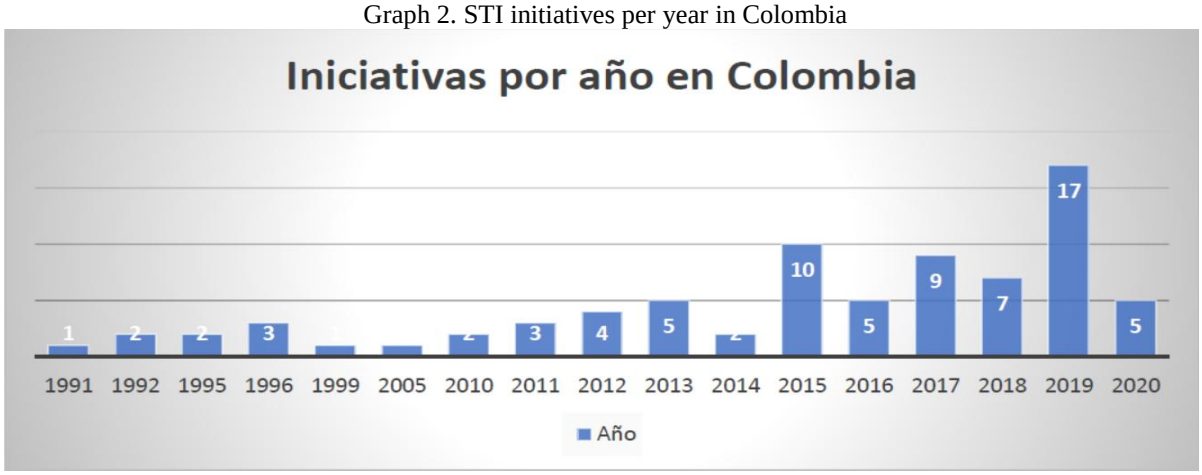
The analysis carried out is qualitative. The survey is taken from 1991 to 2021, where there are 79 initiatives, of which 72% were carried out in the ministries (State Entities). Of these, 50 were carried out by the Ministerio de Ciencia y tecnologíae innovación; however, only 5 of the 18 ministries present initiatives in STI, only 23 entities generate initiative, with respect to the 330 entities presented by the Contaduría General de la Nación in relative terms, the rate of doers of initiatives in STI is 7%, as shown in Graph 1.

Graph 1. Initiatives by Entity



Own elaboration

Graph 2. STI initiatives per year in Colombia



When looking at the initiatives by year, it is seen that 2019 is the one with the highest number of initiatives in STI, the variables to define this substantial increase in proposals.

Qualitative Analysis, Patterns.

The understanding of the networks that are obtained from the software (graphics) depends, in most cases, on the experience in analyzing them, working for many years on different projects. Its visualization is useful to determine which is the grouping, the node of greater interaction, the nodes that are isolated, and different aspects that lead to determine different perceptions to find characteristics (knowledge) of the data that are possessed. However, this process is inherently difficult and requires exploration strategies. The networks that are formed according to the different algorithms that are used, are technically precise and visually attractive. The visualizations of the networks must be supported by an analysis that prospects initiatives to be taken into account for the different policies to be defined by the makers of them. The exploration of them should be with the intention of improving the processes of organizations.

Exploration can be quite complex on large networks; that is, when millions of data must be manipulated. Some requirements can be identified for the software to be used: high-quality design algorithms, data filtering, grouping, statistics and annotation.

Identifying patterns requires hard analysis work after data mining. A matrix is formed in which the entities are in a row and, per column, the initiatives by topic or by type of beneficiary. This matrix is generated and incorporated into the Gephi program, which generate the networks, of course with some parameters. From there the patterns should be looked at with caution. The software has the default algorithm Yifan Hu, with the modality of three classes with a resolution of 0.45. (see Graph 3).

Graph 3. Distribution by modality

1. Patterns of initiatives by theme

The STIP COMPASS survey allows you to view the following initiative topics:

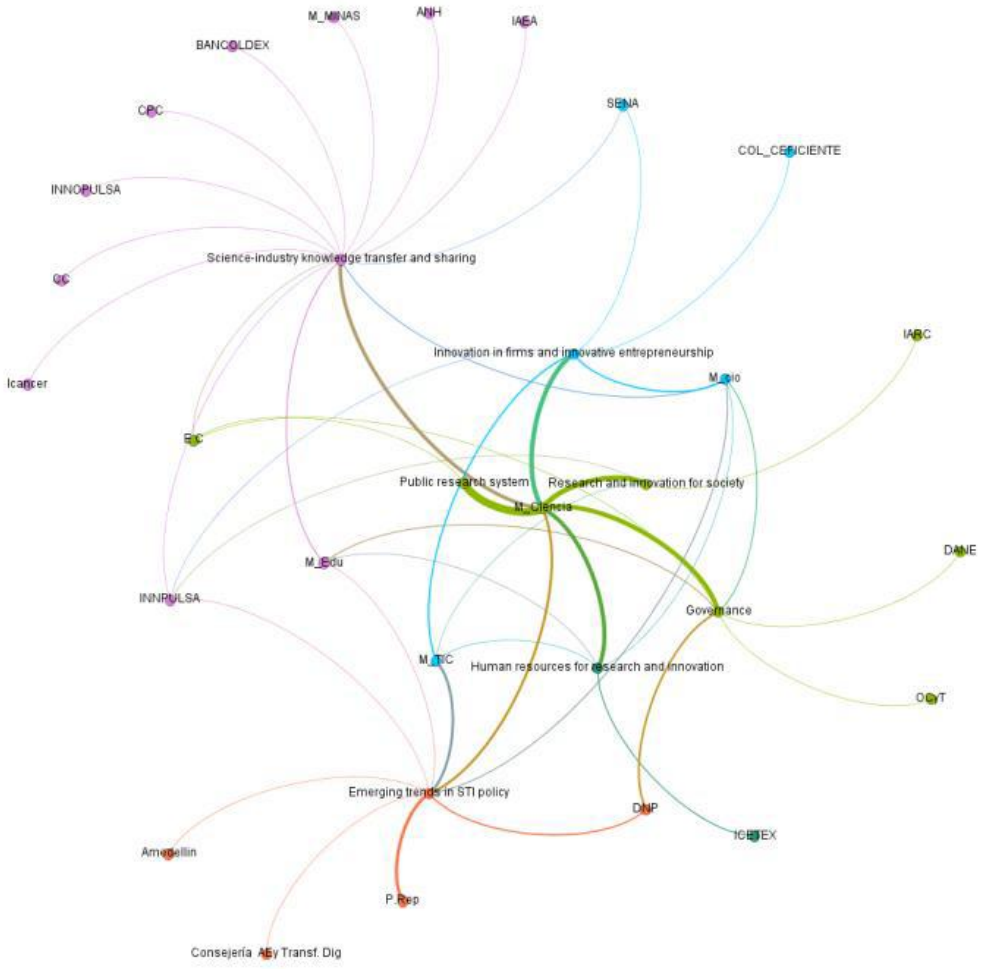
- Governance
- Transfer and exchange of knowledge between science and industry
- Innovation in companies and innovative entrepreneurship
- Human resources for research and innovation
- Research and innovation for society
- Public research system
- Emerging trends in STI policy

The graphs that are generated by descriptive statistics do not allow to visualize what clusters can be that arise; for this reason, networks are taken as a fundamental tool, and in the case of initiatives, because, in a certain way, they provide what is the priority of the initiatives by entity.

The visualization of one of the networks that are formed (Graph 4), intuitively allows to perceive the concentration of initiatives by public entity. The most notorious is the one exercised by the Ministry of Science, Technology and Innovation, where the initiative 'Public research system' dominates, followed by 'Research and innovation for society', finally, 'Innovation in companies and innovative entrepreneurship'.

The interesting thing to see is the formation of communities through initiatives. 'The Transfer and Exchange of Knowledge between Science and Industry' stands out, which is conceived by a cluster of 14 public entities (Colombia), which demonstrates the broad interest in public policies of the Colombian state.

Graph 4. Patterns by Initiative Theme

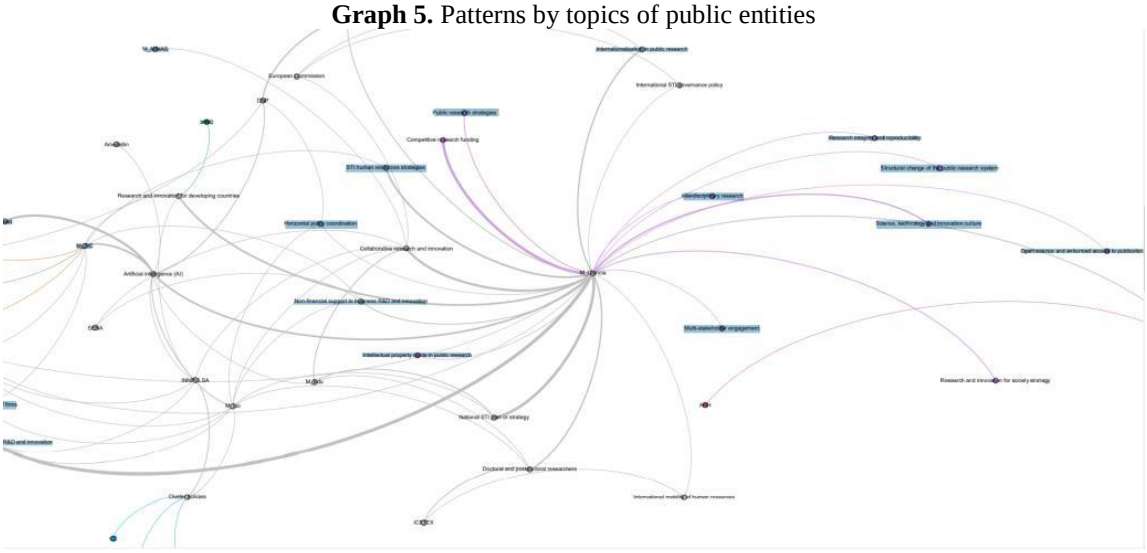


2. Patterns by topics of public entities.

The topics reported in the STIP COMPASS survey are 31.

- Artificial Intelligence (AI)
- Business innovation policy strategies
- Cluster policies
- Collaborative research and innovation
- Commercialization of public research results
- Competitive research funding
- Digital transformation of companies
- PhD and postdoctoral researchers
- Ethics of emerging technologies
- Financial support for business R&D&I and innovation
- Coordination of horizontal policies
- Intellectual property rights in public research
- International mobility of human resources
- Internationalization in public research
- Intersectoral mobility
- Multi-stakeholder engagement
- National STI plan or strategy
- Non-financial support for R&D and business innovation
- Open science and better access to publications and research data
- Public research strategies
- Research and innovation for developing countries
- Research and innovation strategy for society
- Integrity and reproducibility of research
- Culture of science, technology and innovation
- Human resources strategies in STI
- Stimulate demand for innovation and market creation.
- Strategic policy intelligence
- Structural change of the public research system
- Specific support for SMEs
- Transfer and share strategies.

Graph 5. Patterns by topics of public entities



The analysis was carried out giving specificity in the degrees, which resulted in 1,446, with the aim of giving neighborhood by themes and entity to the algorithm. It was not done by modality (Castro & Torres, 2020). The communities or clusters by theme are very atomized, and are not defined as such, however, the

interesting thing are two very isolated (or atypical) topics shown in Graph 6, these are intersectoral mobility carried out by the cancer institute with the initiative strengthening the clinical applications of nuclear medicine and pets, in the National Cancer Institute, with the initiative complying with the regulations on good practices in hospital radio pharmacy and the one carried out by the International Atomic Energy Agency in its theme Transfer and share strategies, also with the initiative harmonization criteria on good manufacturing practices and quality control of radioisotopes and radiopharmaceuticals. There is no documentation in the Ministerio de Ciencia, tecnología e innovación on public policies on the accompaniment by issues or areas to public entities

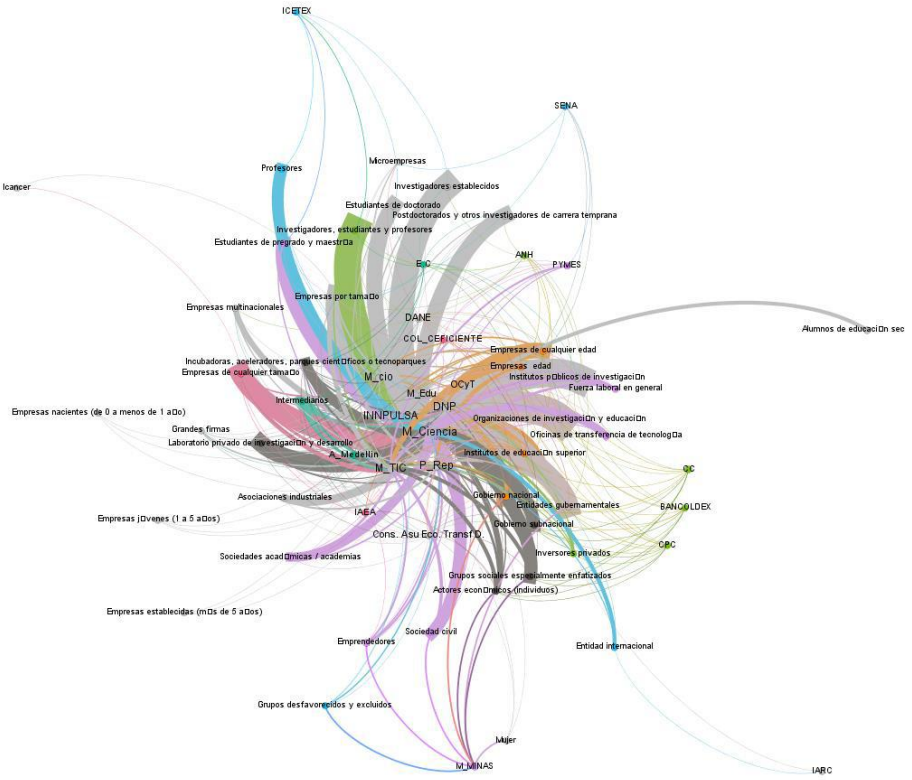
Graph 6. Atypical data

3. Patterns by beneficiaries of the initiatives

The beneficiaries of the survey are described in Table 2.

The objective is to identify the patterns between the makers of initiatives and the beneficiaries, the result of this analysis is visualized in graph 7.

Graph 7. Patterns by beneficiaries of initiatives



A large community can be perceived between public entities and the Ministerio de Ciencia, tecnología e innovación; however, there would be a lack of articulation between ICTEX, SENA, MinMinas, National Cancer Institute, Bancoldex, and other institutes that, in some way, support the development of initiatives in the human or economic spheres. So, the interesting thing is that only three entities work on initiatives where women are the beneficiary, generated by MinMINAS, MinTIC, Consejo Asuntos Económicos y Transformación Digital, followed by the initiatives that young companies have as beneficiaries (1 to 5 years of incorporation), which are carried out by MinTIC.

INPULSA, MinCio, MinCiencia. The most targeted beneficiaries in the initiatives are research and education organizations.

Table 2. Types of Beneficiaries of STI projects.

Beneficiarios directos de la Iniciativa de Política: *		
B.1. Organizaciones de investigación y educación	B.1.1	Instituciones de Educación Superior.
	B.1.2	Institutos de Investigación Pública.
	B.1.3	Laboratorios privados de I + D.
B.2.Investigadores, estudiantes y profesores	B.2.1	Investigaciones establecidas.
	B.2.2	Posdoctorados u otras carreras de investigación temprana.
	B.2.3	Estudiantes de pregrado y maestrías.
	B.2.4	Estudiantes de secundaria.
	B.2.5	Estudiantes de Doctorado.
	B.2.6	Profesores.
B.3.Empresas por tamaño	B.3.1	Empresas de cualquier tamaño.
	B.3.2	Microempresas.
	B.3.3	PyMEs.
	B.3.4	Empresas de Gran Tamaño.
	B.3.5	Empresas Multinacionales.
B.4. Empresas por Edad	B.4.1	Empresas de cualquier edad.
	B.4.2	Empresas nacientes (entre 0 y 1 año de edad).
	B.4.3	Empresas jóvenes (entre 1 y 5 años de edad).
	B.4.4	Firmas establecidas (más de 5 años de edad).
B.5.Intermediarios	B.5.1	Incubadoras
	B.5.2	Oficiales de transferencias tecnológicas.
	B.5.3	Asociaciones industriales.
	B.5.4	Sociedades Académicas.
B.6.Entidades Gubernamentales	B.6.1	Entidades internacionales.
	B.6.2	Gobierno Nacional.
	B.6.3	Gobierno Subnacional.
B.7.Actores Económicos (Individuales)	B.7.1	Empresarios.
	B.7.2	Inversionistas privados.
	B.7.3	Fuerza de trabajo en general.
B.8.Grupos Sociales focalizados	B.8.1	Mujeres.
	B.8.2	Grupos en desventaja y excluidos.
	B.8.3	Sociedad Civil.

Conclusions

The wide possibilities when applying network theory in the analysis of public policies, facilitates perceiving that it is a great technical-methodological tool for the management of large volumes of data, and in this case for the makers of public policies and their evaluation.

The clusters or grouping by themes, by areas and by beneficiaries of public policies show the standardized objectives of the public policies of a country, which has a great relevance when it comes to generating research, analysis and impacts.

The work found shortages in the culture of evaluation of initiatives, and low generation of initiatives in STI, mainly from ministries.

A concentration of STI initiatives in research and education organizations was also found, neglecting women and young entrepreneurs with ventures between 1 and 5 years old.

It was determined that there is no baseline between MinCiencias and the rest of the entities in terms of themes and areas, since they present atomized visualizations, some very dispersed, while by beneficiaries there are very marked trends led by the Minciencias covering a large number of the beneficiaries standardized by the survey.

Thanks

Los autores expresan sus agradecimientos de manera especial al doctor Juan Salamanca, PhD Filosofía del Diseño Instituto de Tecnología de Illinois, y al doctor Galo Edmundo Tovar, Asesor del Viceministerio de Ciencia y Tecnología e Innovación; por su apoyo, observaciones y direccionamiento.

The authors express their special thanks to Dr. Juan Salamanca, PhD Philosophy of Design Illinois Institute of Technology, and Dr. Galo Edmundo Tovar, Advisor to the Vice Ministerio de Ciencia, Tecnología e Innovación; for their support, observations and direction.

Bibliography

[1]. Bastián M., Heymann S. y Jacomy M. (2009). Gephi: un software de código abierto para explorar y manipular redes. Actas de la Conferencia Internacional AAAI sobre Web y Medios Sociales, 3 (1), 361-362. Obtenido de https://ojs.aaai.org/index.php/ICWSM/article/view/13937 [10/01/22].

[2]. Blondel Vincent D., Guillaume Jean-Loup, Lambiotte Renaud, Lefebvre Etienne (2008). "Despliegue rápido de comunidades en grandes redes". En: Journal of Statistical Mechanics: Theory and Experiment, (10), p.1000.

[3]. Lambiotte R., Delvenne J.C., Barahona M. (2009). Laplacian Dynamics and Multiscale Modular Structure in Networks.

[4]. Castro S., Torres L.C. (2020). Algoritmos para la administración pública, ad portas de 5G. Cali, Colombia

[5]. Salamanca F. (2012). Designing Smart Artifacts for Adaptive Mediation of Social Viscosity: Triadic Actor-Network Enactments as a Basis for Interaction. Illinois Institute of Technology Illinois Institute of Technology.

[6]. Sandoval Nancy, Potes Alexander, Arboleda Ana María, Salamanca Juan Manuel, Arce-Lopera Carlos (2014). Las TIC aplicadas a los factores de percepción visual, identificados de manera experimental, que influencian la intención de compra online de productos vegetales. En: Sistemas & Telemática, vol. 12, núm. 28, pp. 53-77. Universidad ICESI, Cali, Colombia.

[7]. Van Geenen Daniela (2020). Análisis de rendimiento crítico para métodos digitales: el caso de Gephi. En: Marcus Burkhardt, Mary Shnayien, Katja Grashöfer (Hg.). Exploraciones en culturas digitales. Lüneburg: Meson Press, S.1–21. DOI: https://doi.org/10.25969/mediarep/14855.