



## Las redes de la comunicación científica. Análisis de revistas especializadas e Índices Bibliográficos Internacionales

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**Resumen.** Los Índices Bibliográficos Internacionales (IBIs) como Science Citation Index y Scopus, han adquirido protagonismo en la ciencia. Sin embargo, su ascenso ha sido polémico y alrededor de ellos se han configurado visiones a favor y en contra de su uso como herramientas objetivas para representar y seguir el estado de la ciencia. Esto ha conducido a profundas tensiones entre ambos polos expresadas en oposiciones del tipo: “los IBIs son/no son herramientas objetivas, científicas y universales”. No obstante, es paradójico que ambos polos se presenten como excluyentes entre sí cuando en la realidad las denuncias de uno y otro dan cuenta de aspectos que coexisten en el proceso comunicativo. En este artículo analizamos esta coexistencia. El artículo resultado de investigación se concibe aquí como un objeto tecno-científico, en el contexto de la teoría del actor red y las metáforas de seguimiento: óptica, industrial y asociativa, para analizar las redes de comunicación científica. Este artículo tiene un objetivo doble: primero, proponer tres redes de seguimiento de la comunicación científica: manifiesta, subyacente y asociativa, para reconsiderar las denuncias a favor y en contra de los IBIs, y segundo, contribuir a la reflexión sobre la oposición enunciada a partir de una visión relacional, no sustancial, del proceso de la comunicación científica.

**Palabras clave:** CTS; cienciometría; teoría del actor-red; mediaciones, revistas especializadas.

## [en] Scientific communication networks. Analysis of journals and International Bibliographic Indexes

**Abstract.** *International Bibliographic Indexes* (IBIs) like Science Citation Index and Scopus have played an important role in the field of science. However, IBIs increased use has been controversial and has raised positive and negative standpoints regarding their use as objective tools to represent and track the state of science. This has led to the emergence of deep tensions between both sides, expressed in oppositions like: IBIs *are/are not* objective, scientific, and universal. However, it is paradoxical that both sides are presented as mutually exclusive when all their complaints consider aspects that coexist in the communication process. We present evidences of this coexistence. In our approach, research papers are conceived as a techno-scientific object in the context of actor-network theory and metaphor tracking: optical, industrial, and associative, to analyze scientific communication networks. The aim of this study is twofold: first, we propose three networks to track scientific communication: manifest, underlying, and associative, to reconsider both positive and negative allegations about IBIs. Secondly,

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we encourage to rethink the opposition, starting from a more relational approach rather than an essentialist one to the process of scientific communication.

**Keywords:** STS; scientometrics; actor network theory; mediations; journals.

**Sumario.** 1. Introducción. 2. Manifest Scientific Communication Network. 3. Underlying scientific communication network. 4. Associative scientific communication network. 5. Conclusions. 6. Acknowledgments. 7. References

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## 1. Introduction

During the second half of the XX century, the *International Bibliographic Indexes* (IBIs) oriented to the analysis of citations have acquired a key role in the field of science, concretely in at least four key aspects of scientific communication: (1) communication channel for quality scientific outcomes; (2) main foundations of evaluation criteria for scientific performance; (3) publishing market niches (via data bases); (4) important sources for studies on research field dynamics.

Concurrently, a *doxa* based on the efficacy and objectivity of IBIs<sup>3</sup> as excellent tools to represent the state of science has been established. However, since the 1980s and 1990s, some critical current scientific claims have emerged (heterodoxies) as to the role of IBIs, and these have been proliferating with greater momentum.

In this context, there are deep tensions between those identified with the positions of the *doxa* or *heterodoxy*. The paradox is that what is seen theoretically as positions that exclude each other and which are expressed as oppositions of the type “IBIs are/are not objective, scientific and universal tools,” appear to coexist in common scientific activity. For example, a researcher interested in publishing the results of his/her work may simultaneously recognize the IBIs as facilitators in communicating quality scientific information at a global level, without giving up the intuition that there are non-scientific interests and motivations that directly affect the building of these indexes<sup>4</sup>.

In addition, nowadays quality and visibility conditions of SJCE experience permanent transformations through time due to practices such as the widening of coverage from 2006–2009 done by Web of Science (WoS) or the incorporation of National Date Base in WoS. A set of transformations indicate that the quality / non-quality demarcation is not an impenetrable border but a border with intense traffic in both directions.

Despite this, conceptions that speak of “unbridgeable gaps” have guided much of the discussion regarding the role of the IBIs as legitimate or illegitimate entities to demarcate quality scientific information. Scientific communication via scientific

<sup>3</sup> The *doxa* and *heterodox* terms are used in this work following the sociological perspective of Pierre Bourdieu (2001).

<sup>4</sup> The reader is informed that throughout the text IBIs is related to indexes used to analyse citations.

journals is principally examined through bibliometric analyses of a functional, systemic or translation type (Cuartas, 2013). These approaches offer a researcher various theoretical and methodological conceptions as to the communication process<sup>5</sup>. They all have a common point: their starting point and analytical focus are reports built and offered by IBIs, thus anchoring them to the visions promoted by the *doxa*.

This shared starting point becomes problematic – both, methodological and analytically - when researchers seek scientific journals and communicative events (SJCE) that do not participate in the IBIs. From the focus of the *doxa*, it is assumed that a journal or communicative event that is negatively demarcated in the IBIs has a low, or no quality at all and therefore, those that venture to analyze it may only corroborate the causes and conditions that led to its exclusion from the IBIs. From the heterodox perspective, to study a negatively demarcated journal means considering the presence of idiomatic, geographic and disciplinary bias that influence this type of demarcation. However, the studies carried out in the heterodox perspective, have been mainly empirical until now and do not offer a comprehensive analytical framework of the communicative process set.

Furthermore, we don't have analyses that allow to understand the apparent exclusion/non-exclusion paradox in SJCE, which currently goes on in modern scientific communication networks. This proposal aims to add more elements in this discussion; in this way, a new analytical framework based on the Actor Network Theory (ANT) is proposed, which we consider useful as an approach to the problem of scientific communication among experts.

The aim of this study is to propose three networks for tracking scientific communication: manifest, underlying, and associative; to reconsider both positives and negative allegations about IBIs, and encourage rethinking of the opposition mentioned before, starting from a more relational approach rather than an essentialist one, to the scientific communication process.

Applying the ANT, research papers will be considered techno-scientific objects and our interest is to reflect the networks through which these communicative events transit when materialized in scientific journals, to obtain a more comprehensive vision of the scientific communication process.

The interest in the scientific communication problem has been fundamental in the ANT. Since its beginning, this theory has reflected the continue movements and intersections that explain the transition process from an object to a research paper, i.e. what is referred to as “circulating reference” (Latour, 1999). Despite this, though this theory is useful as support, we are on a different plane of analysis; we assume that once research papers are written, it is essential to follow the intersections and movements that explain the greater or lower degree of quality and hence, visibility they acquire.

The techno-scientific objects at ANT are followed to the places through which they transit (Latour, 2010). About this, Bruno Latour has continuously resorted to “tracking” metaphors related to optics, theater, fetishes, industry, trekking paths and

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<sup>5</sup> Each of these bibliometric theories is inspired respectively in functionalist sociology, systems theory and the actor-network theory.

arithmetic, with a twofold purpose: first, to discuss the degrees of reality/construction of techno-scientific objects, and second, to make the advantages and disadvantages of the explanatory models often used to follow and understand these objects accessible to the reader (Latour, 1999; 2012; 2014).

We have identified three *tracking networks* in the scientific communication problem:

- Manifest scientific communication network (MSCN): used to report the type of tracking that *doxa* applies to the communication.
- Underlying scientific communication network (USCN): analyzes some aspects of communication identified from the heterodoxy.
- Associative scientific communication network (ASCN): proposed as a new approach which extends historicity and sociability to the demarcation process of communications quality.

For these networks, we will show: (1) in which ways scientific communication problems have traditionally been approached from the *doxa* and heterodoxy, and (2) a new type of relational approach which is more comprehensive of the communicative process, called *Associative scientific communication network*.

To analyze these tracking networks, three reflection axes are postulated to establish similarities and differences (see Table 1)<sup>6</sup>:

- The types of nodes and conducts that make up the communicative cycle and its categorization as scientific and non-scientific.
- The condition of reality/construction that is given to the degrees of quality and visibility of SJCE.
- The valuation of the transformations that occur over time per the visibility and quality of SJCE.

Table 1. Analysis scheme

<b>Approach</b>	<b>Axis 1</b> Types of nodes	<b>Axis 2</b> Condition of reality/construction	<b>Axis 3</b> Transformation over time	<b>Networks</b>
Doxa				Manifest Network
Heterodoxy				Underlying Network
Associative				Associative Network

<sup>6</sup> These three streams of thought are configured from extrapolate and adapt, to the problem of scientific communication, some analytical axes used by Bruno Latour in his metaphors of “tracking”: The ontological condition of techno-scientific objects (reality/construction) and the relative existence of techno-scientific objects over time.

## 2. Manifest Scientific Communication Network

The MSCN is the tracking type that is observed through the traditional international bibliometric indicators. MSCN has its origins in functionalist sociology of science, founded upon the empirical procedures provided by bibliometrics; the science citation Index (SCI) is the technological expression of this union (Merton, 1977a; Leydesdorff, 1987; Gomez, 2004).

Since the creation of the SCI, it has been possible to build a core science that demarcates scientific communication in terms of quality, of good or bad science (Guédon, 2001). Legitimacy of this demarcation has rested on the supposition that in all the communicative cycle, the scientific community constantly shapes it, according to its own criteria of science quality and originality; it controls the positive/negative demarcation of the communicative event<sup>7</sup>.

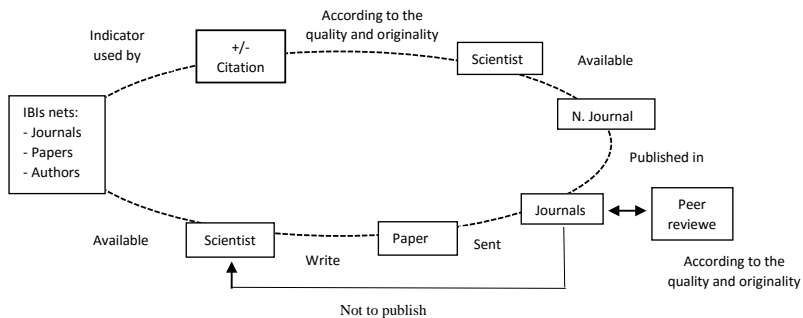
Under this perspective, the IBIs constitute a node of neutral representation that supposedly expresses in a transparent and objective routine the demarcation processes in such a manner that quality papers transfer this attribute to the scientific journals given that the IBIs positively demarcate the journals which have a high number of citations.

In this network (see graph one), the researcher develops a paper and has reports produced by the IBIs, which allow him/her to examine the state-of-the-art for the matter of his or her interest and identify the journal where the results may be more visible. The index reports reflect global scientific production that has been positively demarcated, i.e. most advanced research and also the journals in which it is mainly communicated. In this context, the researcher sends the paper to scientific journals that have expert evaluators in the matter. They review the paper and decide if it should be published or not in the journal according to quality and originality criteria<sup>8</sup>. If the paper is approved, it will be in print in some later edition of the journal and will be available to the scientific community in general. Then, this community decides to use or not to use the paper considering its quality and originality, and accordingly the paper shall be cited to a greater or lesser extent, a practice used by the IBIs as an indicator (Impact Factor) to build their hierarchical scientific communication reports. These reports will again be placed at the disposal of, (communicated to) researchers, in this manner restarting the cycle again.

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<sup>7</sup> According to Robert Merton (1977b) the reward system for science reinforces institutional emphasis on originality, emphasis clearly seen in the world of scientific publishing. In publishing, the structural coupling between the general interest of the scientific enterprise and the scientists' motivational counterpart is observed. A coupling that is possible thanks to scientific ethos, one that according to Merton has four guiding principles: universalism, communism, disinterestedness and organized skepticism.

<sup>8</sup> Robert Merton (1977b) describes the importance of peer reviewers as legitimizers of the quality in the records in scientific publication.



Graph 1. Tracking in the Manifest Scientific Communication Network.  
Source: By authors.

Therefore, the quality of SJCE are a reality and not the product of a construction to the point that quality and visibility significantly constitute a unit.

The SCI and Scopus citation reports or the bibliometric research of a functionalist and systemic order constantly reflect this type of tracking, either directly or indirectly<sup>9</sup>. Manfred Bonitz (2002) expressed this conception in which scientific activity is interpreted as a competition for excellence, represented as a sort of “Scientific Olympics” where the position of each country in every scientific rank is determined by the number of papers published in SCI. Thus, in research of this type, the uneven geographical orientation and accumulation of academic prestige is interpreted as a factual quality that is neutrally represented by SCI.

Academic *doxa* conceives the scientific communication process as a continuum, i.e. communicative events are and should be followed only by the *nodes, elements and conducts of a scientific order* that allow a constant flow of quality scientific information. The non-scientific elements in the communicative cycle shall be interpreted as a set of undesirable conducts or practices, which must be overcome and constitute outlier circumstances in the communication process.

With respect to quality and visibility transformations of SJCE through time, the widening of WoS coverage from 2006–2009 is examined. This is perceived by *doxa* as a positive occurrence. Since it considers this expansion to be coherent with the development of the communicative process, which expects greater attention to regional interests. Along with this perspective, as WoS expands around the planet, a greater demand for quality scientific information emerges on matters of regional interest (Testa, 2009; 2011).

<sup>9</sup> Direct is understood to be research by functionalist sociology regarding efforts to set up a conceptual framework that explains and legitimizes the process of scientific demarcation, e.g. the reflections of authors such as Robert Merton and Eugene Garfield stand out; Indirect refers to research that does not deal directly with the construction of the conceptual framework of demarcation but constantly use as a starting point for research, demarcations made by the IBIs.

This interpretation assumes that quality papers and journals are such by their own virtue; they only adhere to the scientific community's development contexts that allow them to emerge.

### 3. Underlying scientific communication network.

Since the 1980s to the present, criticism has proliferated (heterodoxy) as to the neutral and natural character of the scientific communication process. This criticism has focused on highlighting various constitutive elements: the "not so" ethical practices, applied by some editors and companies with the purpose of inflating certain journal's Impact Factor (IF) (Hemminsson, Mygind, Skjennald and Edgren, 2002; Falagas and Alexiou, 2008; Rossner, Van Epps and Hill, 2008); the geographical bias in the coverage of scientific production by the IBIs (Spinak, 1996; Basu, 2010); and the undesirable systemic effects generated from the current demarcation model (Hicks, Wouters, Waltman, Rijcke and Rafols, 2015).

In these discussions, it is observed that the IBIs, as well as the information gathered and produced by them, are no longer conceived as neutral and natural nodes in the communication network. Instead, they become the subject of heated debates about their nature and impact on the communication network.

When viewing the underlying aspects in the scientific communication cycle, the "purely scientific" condition of the demarcation process is reconsidered. It is now highlighted that as SCI inserts itself in various kinds of negotiation networks (academic, political, commercial and legal), *good works*, *core publications* and *core journals* go from being fundamental tools for visibility and management of scientific production to quickly becoming resources with universal pretensions to demarcate between good and bad science<sup>10</sup>.

One of the main difficulties to characterize the USCM lies in the fact that research on underlying aspects in the network are in general empirical. With limited conceptual development through which it is possible to reinterpret the communicative cycle set and reveal the mechanisms that influence the configuration of quality for SJCE in the demarcation process.

Therefore, we propose the communication process material and spatial orientation as criteria that facilitate the management and analysis of an important group of underlying elements in the network<sup>11</sup>. Hence, we've chosen to take up this empirical research and interpret it in light of these important guidelines.

For argumentative purposes, we artificially divided the demarcation process in two stages: (1) the demarcation of the journals that belong or not to the IBIs, and (2) the ranking established among the journals positively demarcated. This allows to list in greater detail each type of mediation in these two stages.

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<sup>10</sup> About good works, see Gross, P. (1927); about the development of ideas: core publications and core journals, see Guédon, J. (2001).

<sup>11</sup> Social studies of science have identified science's material and spatial orientation (Lenoir, 1998; Daston, 2008; Daston 2014; Ophir and Shapin, 1991; Livingstone, 2003), however, these have not been conceptually explored very much when scientific communication is analyzed in journals.

Regarding the *spatial orientation*, it is apparent to a greater degree during the moment of positive/negative demarcation, namely, when the journals that will be a part or not of the indexes are selected.

As observed, the SCI has a high concentration of scientific prestige only in certain places, which clearly shows the low coverage of journals at a global level with insignificant participation of Latin American, East European, Asian, Russian, German, French, and African journals, etc. (Meneghini, Packer and Nassi-Calo, 2008; Kosanović and Šipka, 2013; Alperin, 2014; Collazo, 2014; Beigel, 2014a; Aman, 2015). This geographic bias generates serious doubts about the objectivity of the scientific evaluation, based on the number of papers published in the SCI (van Leeuwen, Moed, Tijssen, Visser and Van Raan, 2001; Meneghini and Packer, 2007).

This generates limited participation of non-English speaking science in the SCI (van Leeuwen, et al., 2001; Leff, 2005; Meneghini and Packer, 2007; Lemarchand, 2011). Furthermore, many journals openly promote citing literature from the north as a condition to accept or reject research papers that are produced in other geographies. This practice biases the global or local scope of scientific production. From the very beginning, local work from the north is taken as universal, while local work from the south is obviously understood as a provincial nature work (Hanafi, 2011; Alatas, 2003; Keim, 2008).

This geographical imbalance is equally expressed in local journal and papers citation dynamics. The low-frequency of peripheral scientific journal cites is evident in the case of the SCI journals, while the percentage of citations from international journals is very high (Arunachalam, 1995); this asymmetry appears in an indexed journal such that a peripheral paper is cited less often than a non-peripheral paper (van Leeuwen et al., 2001; Lemarchand, 2011).

In many cases for both the evaluating committees at *top* journals and researchers at international centers, Latin American or African science don't generate much interest since it covers topics that are not very familiar, "local ones". Furthermore, the researchers as well as their institutions are not well known (Gibbs, 1995; Vessuri, Guédon and Cetto, 2014). One direct consequence is that scientists from these areas focus on acquiring scientific prestige by prioritizing research interesting at an international level, thus abandoning problems connected to their region given the local character of these challenges (Arunachalam and Manorama, 1988; Shenhav and Kamens, 1991; Bordons and Fernández, 2002; Vessuri, Guédon and Cetto, 2014).

The effects of these orientations produce an imbalance at a scientific publication level: while local journals might generate greater possibilities of circulating research results on local matters, authors abandon and reject them due to the low international prestige (and even national) they provide, especially since the local journals don't have a necessary wide audience to substantially increase the IF to become a top journal (Beigel, 2013; Bredan, Benamer and Bakoush, 2014).

Finally, the "paying to read" or "paying to publish" cultures that has been created around the IBIs generates a serious access problem to scientific knowledge, and this mainly affects the institutions and civil society in economically developing countries (Lane, 2010; CLACSO, 2015).

The *material orientation* is clearly present upon a positive demarcation, i.e. the scientific communications hierarchy demarcated as positive. Since the advent of the SCI, certain academic sectors have taken on the IF as an end in itself, mainly because



of the close link between the IF and recognition of quality and distribution of scientific prestige. From this perspective, some authors, editors and publishers choose to manipulate the calculation of the IF. The material mediation has a greater presence in cases where editors influence how journal contents are materialized for a positive assessment. In this regard, the following practices are highlighted:

- Publish annual review articles ensuring that papers published in the journal have at least an annual citation.
- Preference for the publication of certain formats; e.g., publishing more texts in review format instead of original research results, since the review format is cited more often than other formats.
- Require authors to include a number of citations related to papers previously published in the journal to have their papers published.
- Select papers to be published in the journal according to the percentage of citations that they may generate for the journal.

Additionally, other authors as Basu (2010) have demonstrated the close relationship between the IF and the journal's materiality. By applying an indicator called *Journal packing density* (JPD), Basu identifies the average number of papers per year in every journal for a specific country. This analysis reveals that the number of papers in a journal issue can also affect the figures game<sup>12</sup>.

In general, as demonstrated in the cited literature, the titles of certain journals have greater weight than others in the science arena, and there are close links between: who publishes, where he/she publishes and a positive or negative demarcation for the communication.

Given the various modes of action set forth above, it is evident that the USCN has practices, nodes and non-scientific elements involved in the flow of scientific information. The nodes are not seen here as neutral and natural elements that affect or transparently represent the demarcation process. On the contrary, this network highlights the creation character of the demarcation process for scientific quality. Quality and visibility features of SJCE are the product of a social construction and therefore, the uneven orientation and geographical concentration of scientific prestige is not understood to be an objective reality, but a construction from both scientific and non-scientific logics existing in the demarcation process.

Yet in the USCN, transformations across time as to quality and visibility for SJCE are evaluated differently. For example, the incorporation of Scielo in WoS and the expanded coverage of regional journals is considered a positive event since it recognizes the quality of the journals that were negatively demarcated previously. Moreover, these expanding coverage practices calls into question the lack of diligence and objectivity of the demarcation system, which is not able to recognize in a timely manner the quality of SJCE (Aman, 2015; Cuartas, Lucio and Leydesdorff, 2016; Repiso, 2016). In this context, some heterodox discourses realize the possibilities offered by new circulation and tracking systems for science such as *Open access* and *Altmetrics*, highlighting the need to build a more fair and effective publishing system

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<sup>12</sup> Basu observed that in 2004, China's JPD had the highest value at almost 180 papers per journal.

to acknowledge degrees of quality (Sotudeh and Horri, 2008; Priem, Taraborelli, Groth and Neylon, 2010; Vessuri, Guédon and Cetto, 2014; Beigel, 2014).

#### 4. Associative scientific communication network

In the previous segments, the main analytical assumptions are expressed in terms of the manifest and underlying networks, which respectively determine quality and visibility conditions for SJCE as a real or constructed condition. Now, we propose a new type of tracking called ASCN which seeks to reveal the fact that the quality and visibility condition of SJCE is both real and constructed. From the associative perspective, a quality and visibility condition is interpreted as a gradual and variable condition and, therefore, acquires a *relative existence* in time<sup>13</sup>.

The ASCN is proposed to recognize the constant transformations in the degree of quality and visibility from a relational but not substantial perspective in the communication process. In this network, we appeal to the Bruno Latour's formula to approach the history of techno-scientific objects, namely, to "give historicity and sociability to non-humans" (Latour, 2014: 376). In our case, we attach these attributes to journals, communicative events and IBIs; likewise, sociability should be considered without limiting this tracking to "strictly" scientific or non-scientific nodes.

In this type of tracking, SJCE do not have a finished and independent stability from the communication network in which they are immersed. Stability or reconfiguration of their quality and visibility degree –relative existence– depends on the transformations arising in its association network.

Under the associative network, to conceive the condition of quality as an inherent property, does not offer much analytical and explanatory clarity to the complexity of the communication process. An example of this is observed in the gap between the degree of quality/visibility of communicative events, journals and IBIs, as the case of high IF journals with high percentages of rejections.

The high IF of a journal is usually considered synonymous of high quality. It's precisely in these cases in which an apparent total harmony is given between the quality of the journal published and the positive demarcation granted by the IBIs. What the MSCN considers to be an objective representation of scientific quality demonstrates the timeliness of understanding the transfer of quality as a reality. However, this statement is questioned, if as it has been observed, in calculating the IF of top journals citations from rejected papers are also counted (Liu, 2007a), which generates noise in the supposed virtuous circle of quality.

Overall, there is a higher percentage of retractions in high impact journals, compared to low impact journals. This correlation is observed in prestigious journals such as Science, the journal with the greatest number of retractions worldwide in 2000-2007 period. Moreover, this journal published two papers that became the Schön scandal and the Hwang scandal (Liu, 2007b).

Despite the scandals surrounding the publication and retraction of these papers, Hwang's retracted paper has given a high number of citations in Science. A paper

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<sup>13</sup> To continue delving into the concepts of *relative existence*, *degree reality* and *network association*, see, Latour, B. (2014).

publicly recognized as lacking in veracity, which is defined as a negative contribution to the scientific world, is paradoxically highly visible and due to the received citations, this paper contributes substantially to increase the visibility/quality of the journal in which it was published (Liu, 2007c).

This gap exemplifies how mistaken it is to interpret and explain the communication process as a transparent and objective representation of degrees of quality and visibility supposedly inherent to SJCE. The formula "quality communicative event = scientific quality journal = positive demarcation" has serious fissures in the reality of the communication process. In this process, as observed in the case of the journal *Science*, there isn't necessarily a direct proportional relationship between the quality of one and the other; there isn't a correlation of the type: the lower the quality of a communication event, the lower the quality of the journal.

Moreover, it must be added that the degree of quality of SJCE varies over time. In the example, we saw that the paper published by Hwangse as a quality communicative event over time dramatically changed in its level of quality. Other similar phenomenon has occurred in the journals included in the growing coverage of regional journals in WoS. In this case, journals that were not considered of quality in some of the national science and technology systems since they were not registered in WoS, are now positively demarcated thus providing a new framework of possibilities regarding the degree of visibility and quality of SJCE included in the index.

This new framework raises serious questions about conceiving a journal's degree of quality as an absolute and finished existence. Conceptions of degrees of always/never break down in this case; about this change we may ask: Have these journals and their contents never had enough quality but now they do? Have they always been of quality but are only recognized now?

What we want to show with these questions is how the scientific communication process leads to the destabilization of the quality degree of a journal conception as a finished existence. SJCE in relation to IBIs acquire an existence -reality- that isn't a definitive existence as it may experience changes due to associative dynamics that occur in the communication process.

Precisely, this associative characteristic, although present in the communication process set, is more evident when we focus on those cases where the collectives make great efforts to access or increase their place in the international indexes. Even though, the agents involved in the communication process do not express it in our terms, the development of the communication process provides clues to this associative character, as seen in:

- A. The proliferation of bibliographic indexes driven by National Science and Technology Systems (NSTS) and enterprises.
- B. The redefinition of demarcation for SJCE via new associations between IBIs.

(A) Between the late twentieth and early twenty-first century, numerous IBIs emerged which reconfigured the state of associations between *communicative events/scientific journals* and the degrees of *quality/visibility*.

Although the WoS continues to this day as the most prestigious international index, the emergence of new IBIs, some NSTS and enterprises has led to the formation of new nodes in the communication network. These allow new visibility possibilities

to emerge for certain scientific publications in specific geographic locations that address some types of research problems that are written in languages historically invisible in the SCI. Thus, a new communication context emerges which reflects an increase in the associative character among researchers, entrepreneurs and managers of science policy in the scientific communication process, even if they do not state it thus.

This associative character is manifested early in the same SCI with the creation of Social Science Citation Index (SSCI) in 1973, in response to a set of concerns and complaints about the index's low coverage for certain areas of knowledge, as was the case for Social Sciences. Consequently, the SSCI provided a greater degree of visibility to Social Sciences SJCE.

The associative nature of this practice tends to go ignored while various emerging indexes, in this case, belong to the same enterprise<sup>14</sup>. However, this monopolistic situation has had a diversification since the late twentieth century with the advent of the Chinese Science Citation Data base (CSCD) in 1989 and the launch of Scopus in 2004. Although each initiative corresponds to different objectives, both are new ways of understanding the demarcation process of scientific communication<sup>15</sup>. On one hand, the CSCD is an initiative carried out by the Library of the Chinese Academy of Sciences, which aims to provide an accurate representation of the state and evolution of Chinese scientific production trying to overcome the idiomatic exclusion bias experienced by Chinese journals in the SCI (Xin-ning, Xin-ming, & Xin-ning, 2001; Kuang-hua, 2004). On the other, Scopus is the result of a business venture that seeks to contest the publishing market previously monopolized by Thomson Reuters; thus, Scopus is betting on the construction of a more inclusive index of journals than the one provided by SCI, especially about those areas in which scientific production has been generally invisible in WoS<sup>16</sup>.

From the 1990s to 2016, there has been a proliferation of National Data Bases (NDB), e.g.: *The Serbian Social Science Citation Index (SocioFakt) in 1990*, *Taiwan Humanities Citation Index (THCI) in 1997*, *Russian Science Citation Index (2009)* and in 2014, *Scielo* that integrates with the Web of Science to produce citation reports.

In general, the events indicate the constant emergence of new nodes in the communication network; principally, "IBIs type" nodes whose objective is to establish high degrees of association with SJCE mainly connected to certain geographic areas that continue to be invisible or are represented in a limited manner in the SCI. These association nodes provide new degrees of visibility and quality to SJCE through which transit in the network is reconfigured and becomes more complex given that a greater number of nodes lead to a greater quantity of and more diverse associations.

**(B)** A good example of the associative complexity is observed through the redefinition of the demarcation for SJCE by new associations among IBIs. These associations among IBIs have become more dynamic principally in relation to WoS,

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<sup>14</sup> Another example of this dynamic is observed with the creation of the Arts and Humanities Citation Index.

<sup>15</sup> In the text we only reflect on Indexes oriented to citation analysis. However, visibility circuits may be broader and more varied than those presented here if we include bibliographic nodes that are not engaged in citation analysis, e.g.: DOAJ, Dial-net, INASP, Latindex, Redalyc, African Journals OnLine (AJOL). About this see, Beigel, F. (2014b).

<sup>16</sup> In the business sector together with Scopus, Google Scholar has increasingly grown stronger since 1998.

precisely with the incorporation of various NBDs to its collection: CSCD in 2008; Scielo and the Korean Journal Database in 2014; and the Russian Science Citation Index in 2015.

With these new associations, the WoS has significantly widened the levels of coverage for its collection at a geographical level, thematic as well as language. These new levels of coverage are evident when comparing data which WoS offers in its *Core collection* versus the *All databases* option. In the case of the alliance between Scielo and WoS, it leads to a substantial increase in WoS coverage of Latin American SJCE for the public health, social sciences and agriculture disciplines (Cuartas, Lucio and Leydesdorff, 2016).

With the emergence of new IBIs, it has been possible to establish new types of associations among SJCE of certain geographical areas and WoS. As we saw for the Scielo case, SJCE acquired certain degrees of quality and visibility at a regional level when they associated with Scielo and at the same time a new context of possibilities was established. Consequently, SJCE once again may be reconfigured by the associations which Scielo establishes with other IBIs as well as WoS.

Going back to this topic, it can be observed that modern communication networks are going through an acceleration process: at one level, new players in the communication process have appeared and at another level the associations which are established among nodes<sup>17</sup>. Furthermore, we consider that the ASCN activates an approach that is appropriate to register the complexity of the scientific communication process expressed in the network's dynamism. With the ASCN, there is an appeal to a relational perspective of the processes set.

## 5. Conclusions

The scientific communication demarcation process between experts has been approached mainly from bibliometric perspectives, that have configured a kind of *doxa* that presents some coherence between the narratives that give relevance to the process and its analysis.

Although currently there are numerous empirical efforts that challenge the explanatory perspectives of this *doxa*, their proliferation has not necessarily implied the contribution of analytical tools to configure more comprehensive explanatory frameworks of the demarcation process. This is the main article's contribution.

ANT offers important elements of analysis on the scientific communication problem. Hence, the manifest, underlying and associative networks become analytical strategies for establishing the scope and limitations of the demarcation process of scientific communication in journals using the *doxa*, heterodoxy and relational perspective proposed here.

The manifest network focuses on the reality of communicative events since they have an inherent and finished existence. It also exclusively inclines towards the analysis of scientific nodes and pathways present in the communication network but it is

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<sup>17</sup> Examples of the emergence of new nodes are: ResearchGate, Academia.edu and Mendeley.

incapable of recognizing the work-construction that enables the communicative process or the relative existence of the degrees of quality and visibility for communicative events.

The underlying network considers the communicative process as a construction. It especially considers elements, motivations and actions of a non-scientific character that take place in the communication process. The relative condition of quality and visibility of SJCE is conceived as an expression of the lack of effectiveness and objectivity of the current demarcation system.

In the underlying network, the material and spatial orientations are configured into useful conceptual axes to attempt to describe the manner in which inequalities in scientific prestige are constructed and distributed in the current communication demarcation system. In this sense, IBIs and scientific journals are not simple media containing quality scientific information in a transparent and passive way. These are two important elements to capture the dynamics of the communication process as long as we do not lose sight that both are objects materially and socially constructed within complex spatial contexts and power relations.

With the support of the ANT, it is also possible to build a new form of tracking the communicative process which is called ASCN that attempts to identify the associative-relational character of this process set. With ASCN, the relative existence of degrees of visibility and quality for journals, IBIs and communicative events is recognized. The set of transformations that the degree may have crossed time are explained from a relational perspective.

The analytical benefits that ASCN tracking may provide need to be combined with research clearly oriented from this perspective; our research on Colombian biology journals goes towards this objective and expects to precisely estimate the analytical capacity and limitation of this perspective.

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