

# Competitive Intelligence: Bibliometric Research on Early Signals

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Considering the importance of the anticipated intelligence issue on the current scenario, this article aims at understanding the scientific production about the subject, contributing to future researchers with greater academic knowledge about the productivity in the area. Therefore, a bibliometric research was carried out on weak signals and correlated matters between 1980 and 2010 and was supported by the literature review about the subject. The suggested analysis contributes to greater academic knowledge on productivity in the field, providing a broad perspective for future researchers who catch sight of this subject as a potential for further studies.

*Keywords:* early intelligence, weak signals, bibliometric research

## Introduction

There are several uncertainties in the competitive environment being currently observed, and the markets are rather competitive, complex, and liable to constant changes. In this scenario, the analysis of environment information has a strategic role for the organizations, and thinking about the changes may generate competitive edges. Through this point of view, it is possible to note the dependence relation between the company and its environment, which justifies the attention that should be focused on the analysis and monitoring of the information from the outer environment.

Information has an increasing importance for the organizations as an aiding resource in several contexts; however, one of the goals for the management of information is to justify the changes in the outer environment, when seeking competitive edges (Choo, 2006).

Anticipating such changes may be crucial for companies, so they can envision the opportunities and reduce the risks that result from the uncertainties of the environment. Accordingly, the management of anticipatory information or even early intelligence stands out, because they allow the company to premeditate the changes that may occur in its competitive environment.

For Lesca (1986), anticipatory information may generally be produced by traces of the environment, namely, weak signals which were studied by Ansoff (1975) in a pioneer approach. For him, the weak signals may suggest changes that may occur in the organizational environment, and for this reason, their identification and interpretation are of prime importance.

Due to the importance of the subject, knowing its scientific production allows greater academic knowledge,

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explains certain issues, and provides assistance for a greater understanding of the existing theories that aim at discussing the subject and identifying existing gaps and unresolved issues (Moran, Souza, Boaventura, Marinho, & Fischmann, 2010).

In view of this scenario, the overall scope of this study is to analyze the scientific production in the academic literature on the subject “weak signals and correlated themes” between 1980 and 2010. The goals are the specific: (1) quantification of productivity on each of the keywords; (2) identification of the most commonly referred authors; and (3) verification of the total number of references made in the last 10 years within the selected period.

The period between 1980 and 2010 was selected so that the research could start after the date of Ansoff’s (1975) article which considered the creator of the subject, and as mentioned by Moran et al. (2010, p. 64), “... The analysis of the last 20 years is enough to encounter historically consolidated concepts and research line trends”.

Considering the importance of early intelligence in the current context, the suggested analysis contributes to greater academic knowledge on the productivity in the field, providing a broad perspective for future researchers who catch sight of this subject as a potential for further studies.

In addition to this introductory item, this study is divided into four other sections. In the second section, there is a short bibliographic review, contextualization, and considerations on weak signals and bibliometric research. In the third section, the methodological proceedings used are demonstrated, and in the fourth section, the results are presented and discussed. The study is then finalized with the considerations on the finding, the limitations of the study, and suggestions for future researches.

### **Bibliographic Review**

The bibliographic review presented below provided the technical support for the implementation of the bibliometric research suggested in the goals set out for this study.

#### **Considerations and Concepts on Weak Signals and Correlated Themes**

Lesca (1986) defined anticipatory information as an array of information focusing on long-term issues and aiming at preemptively detecting changes in the corporate environment for the achievement of competitive edges and the avoidance of threats. It can be fragmented, uncertain, and deficient and determined by environmental traces.

The management of information may represent a paradox for the decision-making process, since managers require proper and accurate information, taking the risk of being caught by surprise, or use weak signals which are vague and fragmented information, not quite specific yet. The solution for this paradox would imply the approach of strategic information management in order to anticipate threats and opportunities (Ansoff, 1975).

Haeckel (2004) added to its stating that it was crucial for organizations to quickly adapt to changes in the environment, remarking that such information systems relied on the skill and competence of individuals to evidence the sense of peripheral signals that might not make sense in one context, but would match others. Schoemaker and Day (2005) also used the term peripheral signals and defined it as missing information which lay beyond the manager’s strategic perspective.

In another more recent study, Schoemaker and Day (2009) used several terms to define early management: weak signals, peripheral signals, and early warning signals. They suggested that the manager should seek weak or early signals, with different points of view to exploit the implications of such information.

The terms early warning signals and warning signals are also used in other studies, such as the study of Blanco and Lesca's (1998) being defined as actions that may indicate the intention, motivation, or situations related to the competitive environment. They emphasized that it was difficult to work with this sort of information due to its anticipatory, ambiguous, and fragmented nature. They considered the term as an equivalent to weak signals created by Ansoff (1975).

Gilad (2006) used the term strategic early warning and defined it as the contemplation of early signals, seeking underlying changes in any type of industry. The author (p. 15) remarked, "The strategic early warning process focuses on weak, ambiguous, early signals, sometimes years before management is due to place them on its radar screen".

Upon the review of the literature on the theme, it is possible to observe certain terms used by authors when referring to anticipatory information, and there is certain congruence of meanings. In Table 1, some of the terms and their theoretical supports are presented. However, they have been previously used as keywords for the bibliometric research that will be set out within the items below.

Table 1

*Terms Found in the Research Literature*

Term	Theoretical support
Alert sensors	Hedberg et al. (1976) as cited in Blanco and Lesca (1998)
Early warning signals	Blanco and Lesca (1998), Shoemaker and Day (2009)
Peripheral vision	Haeckel (2004), Schoemaker and Day (2005)
Scanning the periphery	Schoemaker and Day (2005)
Strategic early warning	Gilad (2006)
Weak signals	Ansoff (1975)

### Considerations on the Bibliometric Research

According to Saes (2005, p. 32), "The quantitative evaluation techniques can be subdivided into bibliometrics, scientometrics, informetrics, and more recently, webometrics". According to the author, all of them have similar functions and aim at measuring the diffusion of scientific knowledge with different approaches. Bibliometrics is defined as the array of studies that quantify the written communication process through the counting and analyses of several characteristics. In the case of bibliometric research, Vanz and Stumpf (2010) defined it as a methodological proceeding purposed to the quantitative evaluation of the scientific production.

Bibliometrics is a field of information science provided with several academic uses; one of them is the centralization of the bibliographic review process on a certain theme, with the analysis of productivity in a determined area and remarking knowledge gaps.

As it appears, no mutual agreement has occurred among the analyzed authors about the pioneer studies on bibliometrics, however, Guedes and Borschiver (2005) mentioned that bibliometrics related to the term "statistical bibliography" used in 1922, whereas Saes (2005) stated that the first study that tried to quantify citations dated back to 1927, but since 1917, this research had already been questioned.

However, there is unanimity towards the consolidation of the term bibliometrics, as it became popular in 1969 by Pritchard for the analysis methods of written information based on bibliographic indicators (Beuren & Souza, 2008; Guedes & Borschiver, 2005; Saes, 2005; Vanti, 2002).

There are several laws and concepts that apply to bibliometrics, but the three most important ones are: (1)

Bradford's law or dispersion law; (2) Lotka's law or inverse-square law; and (3) Zipf's law or law of least effort, as mentioned by Vanti (2002).

Bradford's law, according to Guedes and Borschiver (2005, p. 3), "allows us to estimate the degree of relevance of journals in a given area of knowledge", assuming that "the journals that produce the greatest number of articles on a given subject form a nucleus of journals, supposedly of greater quality or relevance in that area".

According to the study of Moran et al. (2010), Lotka's law focuses its efforts on the productivity of authors, concept that is also embraced by Vanti (2002). To that, Guedes and Borschiver (2005) added that researchers with greater productivity were the ones with greater prestige in a given area. On the other hand, Zipf's law aims at suggesting categorizations through the use of word frequency analysis (Moran et al., 2010), being directly related to the automatic thematic categorization (Guedes & Borschiver, 2005).

In Table 2, there is a summary of the laws and concepts of bibliometrics.

Table 2

*Laws and Principles of Bibliometrics*

Information science		
Bibliometrics		
Laws and principles	Focus of study	Main applications
Bradford's law	Journals	To estimate the degree of relevance of journals in a given area of knowledge.
Lotka's law	Authors	To estimate the degree of relevance of authors in a given area of knowledge.
Zipf's law	Words	Automatic categorization of scientific and technological articles.
Goffman's transition point (T)	Words	Automatic categorization of scientific and technological articles.
Invisible colleges	Citations	Identification of the elite of researchers in a given area of knowledge.
Immediacy or impact factor	Citations	To estimate the degree of relevance of articles, scientists, and journals in a given area of knowledge.
Bibliographic coupling	Citations	To estimate the connection degree of two or more articles.
Co-citation	Citations	To estimate the connection degree of two or more articles.
Literature obsolescence	Citations	To estimate the decline of literature in a given area of knowledge.
Half-life	Citations	To estimate the half-life of a literature unit of a given area of knowledge.
Goffman's epidemic theory	Citations	To estimate the growth and decline ratio of a given area of knowledge.
Elite law	Citations	To estimate the size of the elite of a given population of authors.
Research front	Citations	Identification of a multiple relation pattern among the said authors.
80/20 rule	Demand for information	Composition, broadening, and reduction of assets.

Note. Source: Guedes and Borschiver (2005).

In addition to the three laws presented above, there are other studies and concepts applied to bibliometrics, as per the research of Guedes and Borschiver (2005), such as invisible colleges, impact factor, and the 80/20 rule among others.

For this study, Lotka's law seems to comply both with the general and specific scopes, since the article is mainly focused on the productivity of authors on the suggested theme.

## Methodology

In order to achieve the proposed goals, a bibliometric research was selected, as per the definitions presented within Section 2.2 (Considerations on the Bibliometric Research). This decision is justified in view

of the need to quantify scientific productivity on the theme weak signals, complying with the general scope of this study. Vanz and Stumpf (2010) remarked that the bibliometric research was a methodological proceeding with a view to quantitatively evaluating the scientific production.

For the ascertainment, the database Web of Science<sup>1</sup> was selected, which belongs to the virtual platform ISI<sup>2</sup> Web of Knowledge, because it is described as the primary database in the portal of the coordination for the improvement of higher education personnel (CAPES, 2010), both in the areas of multidisciplinary knowledge and applied social and human sciences. Moreover, as mentioned by Saes (2005), the Web of Science is provided with analysis tools that facilitate the bibliometric research.

For the collection of data, the following keywords found with the literature review presented in Section 2.1 (Considerations and Concepts on Weak Signals and Correlated Themes) have been taken into account: alert sensors, early warning signals, peripheral vision, scanning the periphery, strategic early warning, and weak signals. The keywords were used in English because of the determination of the database. In this regard, it is worth mentioning that the keywords were determined as a function of the reviewed literature. However, there may be other terms in other existing studies.

The area of business and management was chosen, between 1980 and 2010, for reflecting more of the aspects sought by the researcher hereof. Nevertheless, the type of work has not been set out, but articles, conference projects, and working papers were liable to selection in order to render the search omnibus in this sense.

The collection performed on September 6, 2011 stands out. In the bibliometric research comprised in the electronic database, the date of the collection is crucial, because the database is dynamic and can be modified at any time.

The analysis was carried out with the dedicated tools of the platform aiming at reaching the goals proposed for the study through the data provided. An electronic spreadsheet was used (excel) to facilitate the analysis and organization of the data acquired. Projects that are not related to the suggested content have been discarded. Such data are presented and analyzed in the next section.

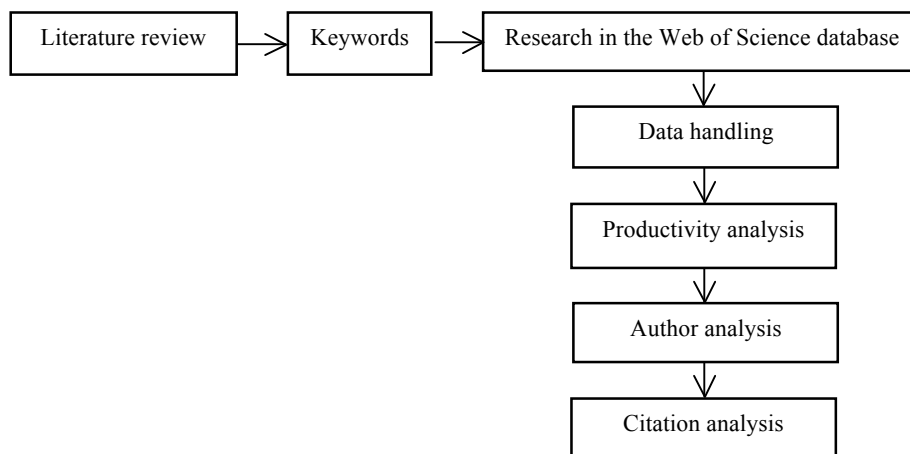


Figure 1. Steps of the methodological proceeding.

The steps of the methodological proceeding can be visualized in Figure 1.

<sup>1</sup> Retrieved from <http://www.isiwebofknowledge.com>.

<sup>2</sup> Institute for Scientific Information.

## Results

Three goals were set forth in the introduction hereof, but the interpretation of the findings encountered in the researched database was focused on such parameters. The first parameter was the quantification of productivity on the theme proposed using the keywords ascertained with the literature review. It was noted that the keywords with greater productivity were peripheral vision and weak signals respectively, which are also the ones with a greater number of citations in the period between 1980 and 2010. Such results can be observed in Table 3.

Table 3

### *Productivity According to the Keywords Between 1980 and 2010*

Term	Total of articles found	Total of citations
Alert sensors	0	0
Early warning signals	11	20
Peripheral vision	20	319
Scanning the periphery	4	6
Strategic early warning	16	45
Weak signals	33	305
Total	84	695

With regard to the mostly referred authors, it is important to remark that the 20 first authors listed were the ones considered, according to the criteria used by Moran et al. (2010) upon the bibliometric research. The list of authors and the total of citations of each project are presented in Table 4 and satisfy the second goal set out for this article. Another remark is that certain authors appear as duplicates in the list, because they relate to different studies.

Table 4

### *List of the 20 First Most Cited Authors*

Early warning signals		Peripheral vision		Scanning the periphery		Strategic early warning		Weak signals	
Author	TT	Author	TT	Author	TT	Author	TT	Author	TT
Mellahi	9	McDougall et al.	197	Day; Schoemaker	7	Thompson et al.	36	Erdem; Keane	148
Heil; Helsen	7	Fairclough	66	Lettice; Parekh	0	Reinhardt	11	Weick	20
Blackhurst et al.	3	Prahalad	22	Brown	0	Zhang et al.	6	Prahalad	14
Berman	1	Zaltman	18	Day; Schoemaker	0	Ruff	5	Gehani	15
Chinta	1	Day; Schoemaker	9			Sawant	1	Konnola et al.	8
Jia; Wang	0	Phillips; Bradshaw	9			Chinta	1	Julien et al.	11
Tian; Li	0	Haeckel	8			Liu	0	Halme	11
Huang et al.	0	Day; Schoemaker	7			Jiang; Zhang	0	Kahane	11
Wilkinson	0	Winter	7			Ahmed et al.	0	Gong et al.	10
Sen	0	Maruyama	7			Zhu et al.	0	Day; Schoemaker	8
		Foss et al.	4					Roberto et al.	8
		Cunha; Chia	2					Haeckel	8

(Table 4 continued)

Early warning signals		Peripheral vision		Scanning the periphery		Strategic early warning		Weak signals	
Author	TT	Author	TT	Author	TT	Author	TT	Author	TT
		Loasby	2					Cunha et al.	6
		Desyllas; Hughes	1					Day; Schoemaker	6
		Klockener	1					Rerup	6
		Schoemaker	1					Del Campo et al.	6
		Klockner; Kolvenbach	0					Gammoh et al.	4
		Anon	0					Konnola et al.	4
		Baden-Fuller	0					Cunha e Chia	2
		Tsoukas	0					Cachia et al.	2

Notes. (1) TT refers to the total of works published; and (2) Source: Retrieved from Web of Science.

Based on the aforementioned, it could be observed in Table 4 that few projects concentrate a great number of citations. However, only three projects are responsible for over 50 citations. Despite the use of the different themes suggested in this study, some studies are not cited simultaneously in the list of different terms and can be adduced with the projects of Day and Schoemaker, specially the one named scanning the periphery, cited both in the analysis of the term peripheral vision and scanning the periphery.

Table 5

*Studies That Came out as the Most Cited Ones in the Bibliometric Research*

Early warning signals	Mellah, K. The dynamics of boards of directors in failing organizations.
	Heil, O. P., and Helsen, K. Toward an understanding of price wars: Their nature and how they erupt.
	Blackhurst, J. V., Scheibe, K. P., and Johnson, D. J. Supplier risk assessment and monitoring for the automotive industry.
	Berman, B. Strategies to detect and reduce counterfeiting activity.
	Chinta, R. Lessons from failure.
Peripheral vision	McDougall et al. Explaining the formation of international new ventures: The limits of theories from international business research.
	Fairclough. Peripheral vision.
	Prahalad. The blinders of dominant logic.
	Zaltman. Consumer researchers: Take a hike.
	Day, G. S., and Schoemaker, P. J. H. Scanning the periphery.
	Phillips and Bradshaw. How customers actually shop-costumer interaction with the point-of-sale.
	Haeckel. Peripheral vision: Sensing action on weak signals making meaning out of an apparent noise.
	Day, G. S., and Schoemaker, P. J. H. Peripheral vision: Sensing and acting on weak signals.
	Winter. Specialized perception, selection, and strategic surprise.
Maruyama. Polyocular vision or subunderstanding?	
Scanning the periphery	Day, G. S., and Schoemaker, P. J. H. Scanning the periphery.
Strategic early warning	Thompson et al. Emotional branding and the strategic value of doppelganger brand image.
	Reinhardt. An early warning system for strategic planning.
	Zhang et al. Predicting information technology project escalation.
	Ruff. Corporate foresight: Integrating the future business environment into innovation and strategy.
	Sawant. The economics of large-scale infrastructure foreign direct investment (FDI).
Chinta. Lessons from failure.	

(Table 5 continued)

Weak signals	Erdem and Keane. Decision-making under uncertainty: Capturing dynamic brand choice processes in turbulent consumer good markets.
	Weick. Gapping the relevance bridge: Fashions meet Fundamentals in management research.
	Prahalad. Weak signals versus strong paradigms.
	Gehani. Concurrent product development for fast-track corporations.
	Konnola et al. Management of foresight portfolio.
	Julien et al. Networks, weak signals, and technological innovations among SMEs.
	Halme. Corporate environmental paradigms in shift.
	Kahane. Scenarios for energy—Sustainable world VS. global mercantilism
	Gong et al. Using on-line sensors in statistical process control.
Day, G. S., and Schoemaker, P. J. H. Peripheral Vision: Sensing and acting on weak signals.	

Note. Source: Retrieved from Web of Science.

With regard to the most cited studies and with a view to supplementing Table 4 and providing reference for future studies, the most cited projects might be observed in each of the researched terms of Table 5, considering up to the 10 first projects of each term under research.

In order to comply with the third goal proposed and set out in the introduction part herein, the evolution of the citation total for each keyword used between 1980 and 2010 is presented in Table 6. An emphasis should be given to the fact that from 1980 to 1999 the years are clustered into a single column to facilitate the reading and because there were few citations in this period allowing for projects with the terms peripheral vision and weak signals.

Table 6

*Evolution of the Number of Citations in the Last 10 Years*

Term	80-99	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Early warning signals	0	0	0	0	0	0	1	2	2	1	4	10	20
Peripheral vision	13	7	12	17	3	18	20	37	42	48	49	53	319
Scanning the periphery	0	0	0	0	0	0	0	0	0	1	3	2	6
Strategic early warning	0	0	0	0	0	0	0	0	6	10	8	21	45
Weak signals	31	18	10	14	14	18	14	23	23	40	47	53	305
Total	44	25	22	31	17	36	35	62	73	100	111	139	695

When observing Table 6, it is possible to note that, in particular, among the different terms used to refer to early signals, the terms peripheral vision and weak signals appear much more frequently as compared with the other researched terms, however, these terms started to appear as of 2005 and 2006, which may suggest that they are more recent. By crossing the information in Table 6 with the data from the projects of the most cited authors, it was noticed that most of the projects of the other researched terms, that is, early warning signals, scanning the periphery, and strategic early warning, date back to 2003.

There was a greater concentration of citations in the last three researched years, accounting for 350 citations between 2008 and 2010. When comparing these data to the total of citations in the other years from 1980 to 2007, a nearly equal number was found, 345 citations for the remaining 27 years, that is, from 1980 to 2007, suggesting growth in the academic interest as of 2008.

Another interesting factor is the small concentration of projects in each of the themes under the analysis as



a function of the importance of the subject in the current context. This fact might represent a knowledge gap and a fertile space for researchers.

### Final Conditions

This research indicates that the productivity of academic studies focused on early signals is still deficient, as well as the total of author citations, which is concentrated only in few studies. All goals set out for this study have been reached and their corresponding results have been presented. It is important to mention that the analysis of the citation evolution has increased after the years of 2005 and 2006.

Although the concept of weak signals was suggested a long time ago by Ansoff (1975), only 33 projects approaching this concept in 30 years seems incipient. Despite being a rather specific term, which could possibly justify such a low volume of citations, it is the base for early intelligence processes (Lesca, 1986) or early warning key intelligence topics (KITs) (Herring, 1999).

This research has not exploited terms such as competitive intelligence in which the concept of weak signals fits well. The concept of competitive intelligence is per se quite disperse and generates several approaches, which hinders a deeper bibliometric research.

In turbulent environments such as the current ones, the deficient attention given to weak signals and early signals in literature, according to the results presented herein, would not be justified. However, as shown in Table 3, the number of citations from 2008 to 2010 has significantly increased with respect to that of previous years, which matches the turbulent moments through which the world has been going through after the crisis of 2008. This issue eventually shows a greater overall concern of companies with the identification of early signals representing the actions in the competitive environment of the current world economy. Other studies could look into this aspect.

This study contributes to the study of potential researchers and may be the starting point for future researches on anticipatory information by showing the existing gaps and the evolution of the researches in the area.

It should be emphasized that, by nature, the bibliometric research presents certain limitations with regard to challenges of its own database, such as categorization, record of authors, and online information recovery issues. Moreover, it is possible to say that certain terms related to weak signals may have not been used in the study, in addition to the geographic limitation imposed by the database which includes few Brazilian studies.

It is the authors' suggestion that other studies should use other databases to compare the findings, including on Brazilian bases, so that the research context can be better exploited in Brazil, broadening its scope.

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