Matrix Indicator System

Victor Cavaller[1]

30 May 2008

Abstract

The aim of this study is to offer a methodological contribution to systematic and strategic analysis of information in organisations.

The analytical procedures are based on the measurement of factors that determine the organisational activity, and currently are developed through heterogeneous definitions and different practices. However, the strategy of organizations requires an integral management of information

On the one hand, the parameters, that constitute the dimensions of the organizational activity, can define the analytical architecture on a matrix. Moreover, from the range of conceptual proposals adopted as information structuring and preparation mechanisms for analysis, the concept of indicator is the key subject that synthesizes our knowledge.

In accordance with this relational structure of parameters, the metric indicators will be classed and arranged in their application according to how they relate to different levels of the activity; according to the mode that refers to the nature of their results; and finally according to how they correspond to a different deployments.
In short, our methodology is based on an indicator system model that follows a matrix architecture. After a synthetic explanation of the parameters that determine and constitute the dimensions of the analytical architecture, is designed the axial structure of our methodological proposal: the Matrix Indicator System.

1 Introduction

Information analysis is the nuclear process of information management. The results from the analytical procedures are integrated into scientific research processes, they help with taking decisions in any sphere of human activity, and they provide the necessary knowledge for designing the strategy of organisations, groups or working groups, etc. For this reason, having a methodology that validates analysis as an integral information management instrument is a matter of huge importance. Finally, it is not only interests that are at stake, but also the survival and progress of the agents that implement the analytical processes.

In this work, we understand that the analytical architecture of the information is associated with the sequential structure of the application of a system of indicators. What lays the basis for the information of an activity or phenomenon are the data that we have. But the data are the result of the measurements of the constants or variables, corresponding to the parameters that describe this activity or phenomenon, and which we obtain on the basis of rigorous observation. The analysis of the relation of these measurements allows us to explain the activity or phenomenon that we observe.

Indicators are defined as “the parameters that are used in the evaluative process of an activity or phenomenon” (Sancho, 2001). We understand that the parameter is the variable element according to which the characteristics of any phenomenon are determined, and the indicator,

[1]Open University of Catalonia, Dept of Information and Communication Sciences. Barcelona (Catalonia-Spain), vcavaller@uoc.edu

H. Kretschmer & F. Havemann (Eds.): Proceedings of WIS 2008, Berlin
Fourth International Conference on Webometrics, Informetrics and Scientometrics & Ninth COLLNET Meeting
Humboldt-Universität zu Berlin, Institute for Library and Information Science (IBI)

in the technical sense given, is the instrument used to show the presence or to measure the intensity of the phenomenon. Given this, we can define indicator as the measurement of the relation between data represented by a phenomenon or activity.

Indicators constitute the measuring element where the progressive complexity of analysis appears. The order of implementation associated with the order of intellection that describes the analytical progress of a system of indicators constitutes its guarantee as a suitable measuring, analysis and control instrument, while providing homogeneity and methodological systematicity to the integral information management process in organisations.

Several recent studies (Mrosek, Th. Balsillie, D. & Schleifenbaum, P., 2006; Potts, T. 2006; Rakel Øvstedal, L., Lid, I.M. & Terje Lindland, T. 2005; Hong Liu, W., Hsiewn Ou Ch. & Huan Ting, K., 2005; Do Santos, T.C.; Crispim, V.R.; Noualhetas, Y.; Macacini, J.F. & Gomes, H.A. 2005) about analysis of sustainability, development, or technical applications, offer examples of the community of modal typology of indicators, and of the effectiveness of indicator systems as a progressive approach in the analysis of information..

An indicator system is "an integrated set of indicators structured as process relations and hierarchies of an organisation that, on the basis of the measurements of its different fields (customers, processes, people, impact and results) and consistent with the strategy and long term, offer, with the capacity for adaptation, a more complete vision of the state and expectations of the organisation" (Pipe Methodology, 2000).

On the one hand, an indicator system is geared towards fully satisfying the information functions when it is part of "a set of information flows with the aim of obtaining suitable results for taking decisions at all levels" (Bueno, 1974). From the perspective of General Systems Theory (Klir, 1969), an information system is "a set of interconnected networks that turn data into information" (Bueno, 1971). For this reason, a great many of the indicator systems that have emerged to date do not constitute genuine information systems as they only offer as a result aggregations of data not structured coherently in a system. An effective information system must provide indicators capable of anticipating future evolutions, enabling directors to identify specific value generation factors (Lev, 2001).

On the other, the indicator system acts as a set of tools for the management of organisations, being a constituent part of what is known as a Balanced Scorecard (BS). A BS "is a system of inter-related objectives, measures, goals and initiatives that together describe the strategy of an organisation and how the strategy has to be achieved" (Kaplan and Norton, 1996), "a management system organised coherently in four perspectives: better economic results, more satisfied customers, improvement to processes, improvement in the action of the workers" (Salgueiro, 2001).

In its original conception, BS (Kaplan and Norton, 1992, 1993, 1997) was put forward as a constant strategy review instrument geared especially towards bringing together the organisation's objectives with those of each employee. It is, in this sense, rather more than an indicator system. BS has to seek a balance between short- and long-term objectives, financial and non-financial measures, provisional and financial indicators and internal and external perspectives. BS is a documentary instrument where the most relevant indicators combine to monitor execution. It comprises the set of tables and graphs (linear, Gantt or PERT) associated to a work place or to a service and represents the monitoring information of an activity that helps in decision-taking.

Presently, despite recognising the validity of BS, the need has been seen in the scientific and business fields to constitute new integrated indicator systems in process relations and hierarchies that offer a more complete vision of the state and expectations of an organisation. BS displays a number of shortcomings, such as the lack of focus of process management, deployment methodologies, reference to the role of providers, a high degree of subjectivity, etc. Besides this, it does not offer a diagnosis of the

initial situation of the organisation, nor does it systematically consider external variables such as the environment and the impact on society (Pipe Methodology, 2000). [2]

2 Analytical architecture

The first aim of this study is to establish the parameters that define the dimensions of the analytical architecture of the information and that determine the analytical procedure of the information, in its heterogeneous definitions and practices. The framework question to be resolved has been: what are the analytical parameters?

2.1 Analytical levels

We can pursue different strategies for defining the levels of analysis of the organisational activity, considering in correspondence the levels of analysis of the information in organisations. These deduction strategies set out to sketch the functional sub-systems of the organisation, determine the order of application of the strategic analysis types of the organisation and, finally, present the levels of monitoring in the organisation. Examples of this progressive approach can be found in work by Porter (1980, 1985, 1990), Calori, Atamer & Laurent (1988), Martinet & Ribault (1989), Portnoff (1990), Laudon & Laudon (1991), Jakobiak, (1991, 1992), Wheelwright & Clark (1992), Verna (1993), Cornella (1994), Werner & Degoul (1994), Lesca, (1994a i b); Martinet & Martí (1995), Michel (1999), Nordey (2000), Lesca & Dourai (2003).

Finally, we can present a classification of the different types of monitoring that brings together the relation of the activity of the organisation with the environment, with the internal structure, resources, organisation and objectives of the organisation, with that of other organisations, expressed globally in financial and economic terms, with the factors that determine its innovative and technological capacity and with the set of factors that guarantee its progress and success.

The deduction structured on the basis of the types of monitoring can be represented in the following table:

Table 1. Levels of analysis and associated type of monitoring

	Level	Type of monitoring
1	Environment	Monitoring the environment
2	Organisation	Organisational monitoring
3	Competition	Competition monitoring
4	Economy	Economic monitoring
5	Technology	Technological monitoring
6	Strategy	Strategic monitoring

According to this series of relations, we obtain the following classification of types of metric indicators: (monitoring) indicators of the environment, (monitoring) indicators of the organisation, (monitoring) indicators of the competition, economic (factor monitoring) indicators, technological (factor monitoring) indicators, strategic (or global monitoring) indicators.

2.2 Analytical modes

We measure information and we define measuring as the action of comparing a quantity, a physical magnitude, etc., with another of the same kind that is taken as a unit or template, from which we get a numerical value, with the aim of establishing relations or the deduction of conclusions.

Measuring begins with the identification of the elements on the nominal scale (names or types) (descriptive mode of the analysis) and with the compatibility of the elements on the cardinal scale (quantities) (quantitative mode of the analysis) (Lafouge, Le Coadic & Michel, 2002). For example, we can identify and label the types of fruit in a basket and then add up the elements of the specific types: the apples, the peaches, etc.

[2] Since the end of the twentieth century, programmes subsidised by the European Union have been convoked that integrate research and development projects combining academic and business institutions which work on producing indicator systems for business excellence, such as the development in the framework of the Excellence Model of the European Foundation for Quality Management (EFQM) and of the ISO 9000 Quality Assurance Model, based on advanced methodologies and application software. Examples of this are the above PIPE methodology – Performance Improvement Through Process Excellence – and PTP software: Performance Through Process, in which ESADE takes part.

The variables, defined as each of the changing parameters used to describe an object, phenomenon or activity may be quantitative if it is represented by a numerical value or qualitative if they are represented by a specific class label. In any case, an order is learned from the comparison that provides the relative position of the objects in the series that they form as a whole: ordinal scale (qualitative mode of the analysis). In our example, we would say that there are more apples than peaches but more bananas than apples.

Then, the range groups that qualify the object of our observation (relating quantities of elements) can be constituted in variables as differentiated entities, which places us at an immediately higher level: in the possibility of operating again, this time to establish the relation between contents that leads us to the description of concepts (relational mode of the analysis). For example, we can define a laxative diet, an astringent diet and a balanced diet on the basis of a selection of fruit proposed for their consumption according to specific properties on the metabolism. The concept of fruit diet (constructed on the concept of fruit) becomes the new conceptual element defined on the basis of the inclusion of a number and a specific combination of a certain type of fruit.

In scientometrics, qualitative indication is derived from the impact indexes. The factor that endorses the quality of a scientific production is the impact that it has had on the scientific community (Maltrás, 2003). Relational indicators or indicators of the relational mode of the analysis (also in 2nd generational relational scientometrics) (Callon, Courtial & Penan (1993) require the presence of the element, the consideration of the significant content which distinguishes it as an element and not only its external relation with other similar elements of the same or a different nature.

The analysis does not end here. We need to establish the relative position of the concepts provided to us by the architecture of the scientific discipline or of the organisational activity (rational mode of the analysis). Following our example, a basic instrument in diet therapy is to know the number of diets that can be designed by type on the basis of the definition of possible food combinations.

Rational indicators draw the network of agents of a universe. In patent bibliometrics, this type of indicator is known as third generation relational (Guzman, 1999). The family of patents is an elementary indicator. Neither the citations which it refers to nor the key concepts that comprise the content of the accompanying reports are considered, but the patent is considered as an element that occupies a position on a map structured according to a network model. The significance of the patent as a synthetic information element is already acknowledged.

Until now, we have described an ascending process in terms of complexity, and we can represent it in a table, relating the operation, the objects, the scale, the origin and resulting variable and the operational result. In table form:

Table 2. Operations, objects, scale, variable and operational result in the metrical analysis phases

N/O	**0**	**1**	**2**	**3**	**4**
Operation	Name	Count	Value	Relate	Rationalise
Operational objectives	Elements	Registers	Series	Contents	Networks
Scale	Nominal	Cardinal	Ordinal	2^{nd} Nominal	2^{nd} Cardinal
Origin variable	Objects	Qualities	Quantities	Degree, range	Concepts
Resulting variable	Qualitative	Quantitative	Degree, range	2^{nd} Qualitative	2^{nd} Quantitative
Operational result	Identification	Number	Position	Concept	Dynamic
Metric indicator types according to author	Descriptive	Quantitative	Qualitative	Relational	Elementary or rational

2.3 Analytical deployments

Considering the interaction between analytic goals and nature of data, we can present circumstantial analysis possibilities corresponding to different deployments, associated with different information analysis techniques. Precursor of this concept may be found in work by Maspons (2002) who suggested different zones of informational needs depending on organizational circumstances.

These circumstantial possibilities can adhere to specific different orientations and are classed as follows. If we consider:

- the selected available information that we describe,
- that it does not reveal a descriptive observation of the data,
- the complementary information available to us,
- the research to obtain more information in results,
- what is potential through innovation or invention depending on trends,
- the integrated set of these orientations.

In short, analytical deployments adhere to the following orientations:

Table 3. Analytical deployments/orientations

	Analytical deployment	**Orientation**
1	Description	Evidence-selection
2	Evidential	No evidence
3	Complementary	Availability
4	Research-expansion	Result
5	Prospective	Innovation-invention
6	Decisional	Integration

2.4 Analytical phases

We have established the monitoring levels that must be included in strategic intelligence which is understood as the systematic treatment of global information of a strategic nature for the organisation, and the modes that comprise the specific cyclical and sequential processes which each level of analysis must follow and which correspond to these types of monitoring.

In every case, the model process has to be reproduced homogeneously which extends from the data to the global integration of the treatment carried out with them:

Observe - identify - analyse - represent - interpret - propose - assess/understand

For each of the above levels, the operating procedure prior to analysis will comprise:

- observation of the sphere of activity of the organisation,
- detection of the descriptive parameters of this activity,
- identification of the relations susceptible to measuring and the respective parameters,
- the creation of the indicators used to measure these relations,
- and the collection and selection of corresponding data according to the descriptive parameters.

When applied to a practical case study, the whole of this operation must be implemented fully referring it to each monitoring type and to each modal indicator type. [3]

Analysis of the information must include the following actions:

- List the different indicator sub-types within each monitoring group based on the nature of the sphere under study. Analyse the indexes that each indicator subtype groups together.
- Consider parameter information sources that list each indicator and explain the calculation of the different indexes that inform the indicator.
- Show the analysis that can be carried out based on obtaining the calculation results.
- Illustrating the infographs that may be derived from this analysis.

[3] In a practical case study, this explanation will be carried out as far as possible, illustrating the processes followed in each case.

- Propose possible interpretations that arise.
- Establish the presentation of these interpretations as main decision-making sources in their position faced with alternative tacit information sources with regard to the execution phase of the organisation's management bodies.

In short, this operation must take place while the following tasks expressed in sections are carried out and which are geared towards the analysis of each group of indicators treated: basic data and data sources of the indicators, description and calculation of the indicators, representation of the indicators, and interpretation of the indicators.

These moments finally determine the aims of the metric routine which consist of the synthesis of:

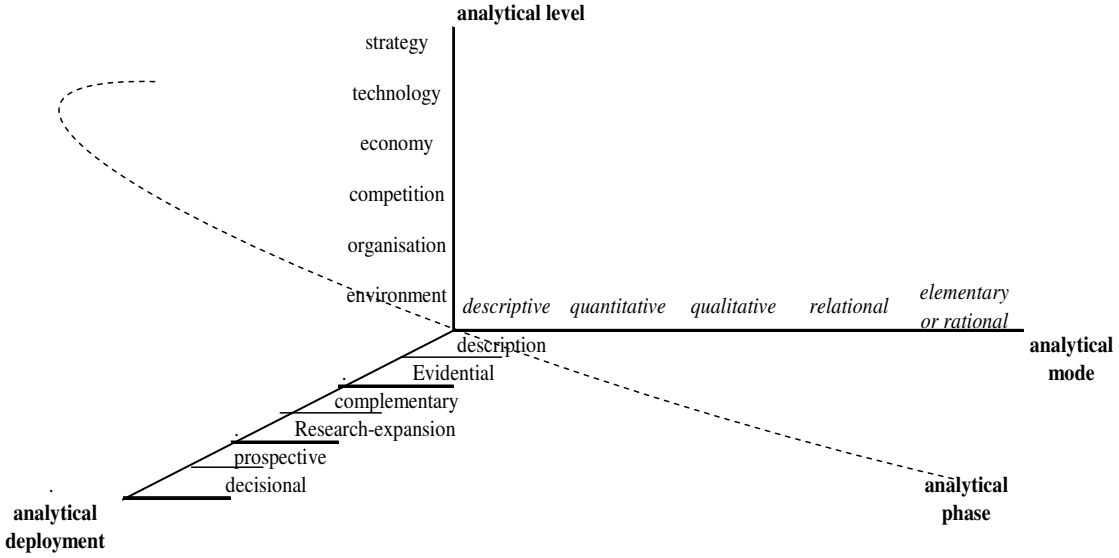
- The series of model indicators for each type displayed.
- The analysis operations that may be carried out based on the inter-relational indicator results.
- The infographic techniques treated in the different types of monitoring.
- The appropriate potential interpretations and decisional hierarchy established on the basis of the sequence of results obtained during the evaluated operations.

3 Parametric coordinates of the analytical architecture

3.1 Parametric coordinates

The graphic representation of the set of parametric coordinates of the analytical architecture can be structured as follows:

Figure 1. Parametric coordinates of the analytical architecture.



In accordance with this relational structure of parameters, the metric indicators will be classed and arranged in their application according to the mode that refers to the nature of their results: descriptive, quantitative, qualitative, relational or rational; according to how they relate to different levels of the activity: of the environment, organisation, competition, economic, technological and strategic; and finally according to how they correspond to a descriptive, evidential, complementary, expansion by research, prospective and decisional deployment.

Table 4. Analytical levels, modes, deployments and phases.

	Analytical level	Analytical mode	Analytical deployment	Analytical phase
1	Environment	Descriptive	Description	Determination of the organisation's interests
2	Organisation	Quantitative	Evidential	Data gathering
3	Competition	Qualitative	Complementary	Creation of indicators and selection of analytical technique
4	Economy	Relational	Research-expansion	Analysis
5	Technology	Elementary or rational	Prospective	Infography
6	Strategy		Decisional	Interpretation

Once the design of the analytical architecture of the information has been attained, the next research objective is to design an analysis methodology based on this architecture. To this effect, a systematic indicator classification structure should be presented derived from the axial connection drawn between dimensions and parameters. This classification lays the basis of our systematic methodological proposal: the matrix indicator system, designed and geared towards arranging the strategic analysis of information in organisations.

3.2 Systematic classification of indicators

It is liable to obtain a classification of indicators, that matches the synthesised analytical architecture, that will have to reproduce the axial connection drawn between dimensions and parameters, and which lays the basis of a systematic methodological proposal.

In accordance with the analytical parameter level, the indicators are classed in relation to practical levels of organisational activity and to associated types of monitoring:

1. Monitoring indicators of the environment.
2. Monitoring indicators of the organisation
3. Monitoring indicators of the competition
4. Economic-factor monitoring indicators
5. Technological-factor monitoring indicators
6. Strategic or global monitoring indicators

In accordance with the analytical parameter mode, the indicators are classed as follows:

1. Descriptive indicators
2. Quantitative indicators
3. Qualitative indicators
4. Relational indicators
5. Rational or elementary indicators.

In accordance with the analytical parameter deployment, the indicators are classed as follows:

1. Descriptive deployment indicators
2. Evidential deployment indicators
3. Complementary deployment indicators
4. Expansion by research deployment indicators
5. Prospective deployment indicators.

3.3 Synthesis of a matrix indicator model

We see that a datum is identified by its participation in the creation of a specific indicator in such a way that its degree of belonging to different levels, modes or analytical deployments can be established. On this point, we can link the basic schema for data analysis provided to us by the matricial model with the architecture of indicators that we have defined:

Matrix system (indicators) X analytical (modes × levels × deployments)

To construct our indicators matrix, we can establish the modes, levels and deployments, taken as meta-variables (MV), in relation to the corresponding meta-modes (MM), to cross the application of the selected indicators for the resolution of any model in different analyses.

Table 11: Basic indicators × meta-variables and meta-modes matrix

				Indicators					
	Operational meta-variable		Meta-mode (MM)	W_{11}	W_{21}		W_{wn}		W_{rn}
MV1	Mode	Mm_{11}	Quantitative						
		Mm_{21}	Qualitative						
		Mm_{31}	Relational						
		Mm_{41}	Rational						
MV2	Level	Mm_{12}	Environment						
		Mm_{22}	Organisation						
		Mm_{32}	Competition						
		Mm_{42}	Economy						
		Mm_{52}	Technology						
		Mm_{62}	Strategic						
MV3	Deployment	Mm_{13}	Description						
		Mm_{23}	Evidential						
		Mm_{33}	Complementary						
		Mm_{43}	Research-expansion						
		Mm_{53}	Prospective						

4 Discussion

The parameters, that constitute the dimensions of the organizational activity, define the analytical architecture on a matrix, where the variables are the levels, modes, deployments and analytical phases. This architecture is useful to design the axial structure of a methodological proposal: the Matrix Indicator System and allows us to obtain a classification of indicators

According to this proposal, the process of information analysis is associated with the sequential and systematic application of indicators and techniques, as a monitoring of the different levels of organizational activity.

Matrix Indicator System is a methodology of analysis that allows us to know the scope of analytical results, assess the validity of our findings, and answer questions like: ¿What are we analyzing? ¿What we are left to analyze?

References

Bueno, E. (1971). *El sistema de información en la empresa (sistemas y modelos contables de planificación y control).* PhD thesis. Madrid: Universidad Autónoma de Madrid.

Bueno, E. (1974). *El sistema de información en la empresa*. Madrid: Fondo para la Investigación Económica y Social de la Confederación Española de Cajas de Ahorros.

Callon, M.; Courtial, J.P.; Penan, H. (1993). *La Scientométrie*. Que sais-je?, nº 2727. Paris: Presses Universitaires de France.

Calori R.; Atamer T..& Laurent P. (1988). "Dynamique des marchés et veille stratégique". *Revue d'économie industrielle*, 46.

Cornella, A. (1994). *Los recursos de información*. Madrid: McGraw-Hill/ESADE.

Do Santos, T.C.; Crispim, V.R.; Noualhetas, Y.; Macacini, J.F. & Gomes, H.A. (2005). "The study of the effects of low-level exposure to ionizing radiation using a bio-indicator system". *Applied Radiation and Isotopes*, 62 (2), 313-316.

Guzmán, M. V. (1999). *Patentometría: herramienta para el análisis de oportunidades tecnológicas*. PhD thesis. La Habana: Universidad de la Habana.

Hong Liu, W., Hsiewn Ou Ch. & Huan Ting, K. (2005). "Sustainable coastal fishery development indicator system: a case of Gungliau, Taiwan". *Marine Policy*, 29 (3), 199-210.

Jakobiak, F. (1991). *Pratique de la veille technologique*. Paris: Les éditions d'organisation.

Jakobiak, F. (1992). *Exemples commentés de veille tecnnologique*. Paris: Les éditions d'organisation.

Kaplan, R.S.& Norton, D.P. (1992). "The balanced scorecard – measures that drive performance". *Harvard business review*, 70 (51), 71-79.

Kaplan, R.S. & Norton, D.P. (1993). "Putting the balanced scorecard to work". *Harvard business review*, 71 (5).

Kaplan, R.S. & Norton, D.P. (1997). *Cuadro de mando integral (The Balanced Scorecard)*. Barcelona: Gestión 2000.

Klir, G.J. (1969). *An approach to general systems theory*. New York: Van Nostrand Reinhold.

Lafouge, T.; Le Coadic,Y.F.& Michel, Ch. (2002). *Eléments de statistique et de mathématique de: infométrie, bibliométrie, médiamétrie, scientométrie muséométrie, webométrie: cours avec exemples et exercices corrigés*. Villeurbanne: Presses de l'Enssib, École supérieure des sciences de l'information et bibliothèques.

Laudon, K.C.; Laudon, J.P. (1991). *Business Information Systems*. Orlando, Florida: The Dreyden Press.

Lesca, H. (1994a). *Veille stratégique, I'intelligence de l'entreprise*. Aster, Giéres.

Lesca, H. (1994b). "Veille stratégique pour le management stratégique: état de la question et axes de recherche". *Économies et sociétés*, 28 (5), 31-50.

Lesca, H.; Dourai, R. (2003). *Traque et remontée des informations de veille stratégique anticipative: une approche par la notion d'épanouissement de soi*. [Consulted: 17/03/2008]. Available at: <http://veille-strategique.eolas-services.com/docs/2003-lesca-dourai.pdf>.

Lev, B. (2001). *Intangibles: management, measurement, and reporting*. Washington, D.C.: Brookings Institution Press.

Maltrás, B. (2003). *Los indicadores bibliométricos: fundamentos y aplicación análisis de la ciencia*. Gijón: Ediciones Trea.

Martinet, B.; Martí, Y-M. (1995). *L'intelligence économique: Les yeux et les oreilles de l'entreprise*. Paris: Éditions d'Organisation.

Martinet, B.; Ribault, J.M. (1989). *La veille technologique, concurrentielle et commerciale*. Paris: Les éditions d'organisation.

Mattessich, R. (1964). *Accounting and Analytical Methods.* Homewood, Illinois: Richard D. Irvin, INC.

Michel, J. (1999) "Veille informative, veille strategique, intelligence economique..... mais au fond, qu'est-ce que la veille?". In: *Journée d'information "Outils de veille pour l'entreprise"*. [Consulted: 01/03/2008]. Available at: <http://wwwparis.enpc.fr/~michel-j/publi/JM318.html>.

Mrosek, Th. Balsillie, D. & Schleifenbaum, P. (2006). "Field testing of a criteria and indicators system for sustainable forest management at the local level. Case study results concerning the sustainability of the private forest Haliburton Forest and Wild Life Reserve in Ontario, Canada". *Forest Policy and Economics*, 8 (6), 593-609.

Nordey, P. (2000). "De la documentation à l'intelligence économique". In: *Lettre de la Net Economie*, 34. [Consulted: 12/03/2008]. Available at: <http://membres.lycos.fr/dessie/docie.htm>.

Pipe Methodology (2000). *PIPE Methodology: Performance Improvement Through*

Process Excellence. ESADE. [Consulted: 01/03/2008]. Available at: <http://www.esade.es/esprit/esp/resultados/metodologia.html>.

Porter, M.E. (1980). *Competitive strategy: techniques for analyzing industries and competitors*. New York: Free Press.

Porter, M.E. (1985). *The competitive advantage: creating and sustaining superior performance*. New York: Free Press.

Porter, M.E. (1990). *The competitive advantage of nations*. New York: Free Press.

Portnoff A. Y. (1990). "Une stratégie globale". *Science et technologie*, 27-28.

Potts, T. (2006) "A framework for the analysis of sustainability indicator systems in fisheries". *Ocean & Coastal Management*, 49 (5-6), 259-280.

Rakel Øvstedal, L., Lid, I.M. & Terje Lindland, T. (2005). "How to evaluate the effectiveness of a tactile surface indicator system*?" International Congress Series*, 1282, 1051-1055.

Rodríguez, O. (2003): "Indicadores de capital intelectual: concepto y elaboración". In: *1r Congreso Internacional y Virtual de Intangibles*. Instituto Universitario de Administración de Empresas. Universidad Autónoma de Madrid. [Consulted: 01/03/2008]. Available at: <http://www.iade.org/files/rediris2.pdf>.

Salgueiro, A. (2001). *Indicadores de gestión y cuadro de mando*. Madrid: Díaz de Santos.

Sancho, R. (2001). "Directrices de la OCDE para la obtención de indicadores de ciencia y tecnología". In: *Actas del V Taller Iberoamericano e Interamericano de Indicadores de Ciencia y Tecnología*. [Consulted: 01/03/2008]. Available at: <http://www.ricyt.edu.ar/interior/normalizacion/V_taller/rsacho.pdf>.

Stevens, S.S.. (1959). "Measurement, psychophysics and utility". In Churchman, W.C.; Ratoosch, P. (eds). *Measurement.* New York: John Wiley & Son.

Verna, G. (1993). *La veille technologique: une ardente necessité*.. Université de Laval (Département de Management). [Consulted: 01/03/2008]. Available at: <http://www.fsa.ulaval.ca/personnel/vernag/PUB/veille.html>.

Werner, E. & Degoul, P. (1994). "La veille technologique, un nouveau métier pour I'entreprise". *La recherche,* 25 (269).

Wheelwright, S.C.; Clark, K.B. (1992). *Revolutionazing product development*. New York: The Free Press, MacMillan Inc.