BUSINESS INTELLIGENCE : INTEGRATING KNOWLEDGE INTO THE SELECTION OF EARLY WARNING SIGNALS

Sylvie BLANCO and Humbert LESCA
Ecole Supérieure des Affaires, C.E.R.A.G.
University Pierre Mendès France, Grenoble 2, France
sylvie.blanco@cea.fr ; lesca@esa.upmf-grenoble.fr

(1998-Articlewksp)

ABSTRACT

This article is an attempt to better understand the relationships between Business Intelligence and Knowledge Management. First, we identify and explain a major problem for organisations facing rapidly changing environments : the selection of Early Warning Signals (EWS). Then, as empirical data about this task are quite unaccessible, we have conceived a support that is an "artefact" enabling us to observe people in an actual selection situation. It is briefly presented alongwith one of its implementation. So, we present the relationships between Business Intelligence and Knowledge Maangement that have been uncovered through this field study. Finally, we formulate theoretical implications and future research avenues.

1. INTRODUCTION

By introducing the expression *"Strategic Management"*, Ansoff (1975) highlighted the necessity to focus on organisations' ability to anticipate threats and opportunities, in order to cope with the turbulence of the environment.

Actually, various field studies confirm that standpoint. Successful organisations are those who detect major events through *"alert sensors"* (Hedberg et al., 1976), who gather more information, with more diversity and more frequently (Daft et al., 1988), who acquire strategic information and interpret it in order to use it for action (Thomas et al., 1993).

But practically, this task seems to be quite problematic (Ansoff et al., 1979 ; Porter, 1980 ; Aaker, 1983 ; Vandenbosch et Huff, 1997). Even organisations who have implemented BI systems often do not manage to anticipate strategic suprises (Gilad, 1988 ; Lesca, 1994). In both cases (with and without BI systems), most of them seem to suffer from both information overload and lack

of "strategic information" which leads us to question their information gathering strategies.

2. BUSINESS INTELLIGENCE : SOME LIMITS IN TAKING INTO ACCOUNT EWS

2.1. BI as an uncertainty reduction process

According to Galbraith (1973), *"If the organization is faced with greater uncertainty, due to technological change ...increased competition... the amount of information processing is increased"* which amounts to increased task uncertainty. So, a major consequence is the necessity to reduce that uncertainty by ensuring the "fit" between information-processing needs and information-processing capabilities.

One of the two approaches identified by Galbraith is to increase the information-processing capabilities until they fit the amount of information-processing needs. It consists in creating processes and mechanisms to acquire and exploit the information required by the considered task. This approach of uncertainty reduction is presented in figure 1.

Business Intelligence is typically an uncertainty reduction process which consists in increasing information-processing capabilities. For instance, March and Feldman (1981) noted that the intelligence an organization possesses about its environment depends on its ability to acquire, analyze and retrieve relevant information at the right place and at the right time. Lesca (1994) defines BI as : *"The information process through which companies prospectively monitor their environment by gathering weak signals in order to create opportunities and to reduce their uncertainty"*. This approach to BI is presented in figure 1.

Figure 1. BI as an uncertainty reduction process : a conceptual framework

Implementing such systems supposes that the "fit" to be obtained has been clearly identified. Nevertheless, as most existing BI systems don’t seem to be effective, it appears necessary to reconsider both information processing needs and capabilities that are inherent to the anticipation of unpredictable changes in the environment.

2.2. Information processing needs

Authors from strategic management who have dealt with environmental monitoring have highlighted major difficulties. We focus here on two major points often recognized to be crucial : the nature of the information we deal with and the nature of the information processes being used.

Information that is required to anticipate unpredictable changes can be assimilated to weak signals (Ansoff, 1975). They are also called early warning signals (Reinhardt, 1984). EWS can be defined as any actions by a competitor that provide direct or indirect indications about its intentions, its motivation, its objectives or its internal situation (Porter, 1980). However, EWS can also concern the technological, political, economical or social environments (Bright, 1970). Ansoff (1975) and March and Feldman (1981) show that dealing with this kind of information is difficult because of its nature : it is anticipatory, qualitative, ambiguous, fragmentary, of various formats and it may come from very diverse sources. Further explanations are given in table 1.

Table 1. Nature of weak signals

To be more concrete, let consider the following piece of information : "*the research director of our main competitor X has jus left his organisation*". Various interpretations are plausible : a passed event not anticipative ; an EWS of a new technological orientation with which the director doesn't agree ; an EWS of the creation of a firm where this director will implement a promising technology, etc.. It is an ambiguous piece of information which bears various interpretations. Some of them may transform it into an EWS.

These interpretations take part of the processing needs, related to EWS gathering. First, as it is part of a strategic decision process, it is ill-structured, novel and complex (Mintzberg et al., 1976). Hence, reasoning is heuristic rather than algorithmic and subject to individual biases. Second, it refers to sensemaking rather than problem-solving (Weick, 1995).That means that the environment is not a given reality but rather a collective construction created through a process of attention and interpretation (Weick, 1995). It entails that information gathering cannot rely on exhaustive information requirements. It is not directed and conditioned by a given problem but more explorative, guided by mental models (Jonhson-Laird, 1983) and experience (Cyert and March, 1963). Finally, the information process can be divided into three main stages : perception of a stimulus ; interpretation in order to create sense ; learning or incorporation of new information into existing representations (Billings et al., 1980 ; Kiesler and Sproull, 1982 ; Daft and Weick, 1984 ; Cowan, 1986). A critical point in this process is the selection of "relevant" information in situations of time pressure and information overload (O'Reilly, 1980). The following quotations support that standpoint : *"Detection of weak signals*

requires sensitivity, as well as expertise, on the part of the observers", (Ansoff, 1975) ; *"In other words, managers must be able to scan environments selectively so that timely decisions can be made"* (Hambrick, 1982) ; *"Managers literally must wade into the ocean of events that surrounds the organization and actively try to make sense of them"*. (Daft et Weick, 1984) ; *"Somehow, the tidal wave of environmental data must be funneled down to a small pipeline of information"* (Smircich et Stubbart, 1985). So we can state that one of the major information processing need in the context of environmental monitoring lies in the **selection of weak signals**. It must be considered as a collective information process which consists in transforming raw data into EWS. Hence, environmental scanners' role encompasses an interpretive dimension. They are not only seen as raw information transmitters.

2.3. Organisations' information processing capabilities

To face these information-processing needs, organisations possess information-processing capabilites that can be assimilited to their information systems, to the extent that "information systems" is understood in its broader sense. More precisely, concerning the gathering of BI information, information-processing capabilities may include three dimensions which are individuals, organisational structure and information technologies.

Individuals who are assigned to an information gathering task are often called environmental scanners or gatekeepers. They are persons who access potentially interesting information sources (Thiétart and Vivas,1981 ; Aaker, 1983) or who hold specific knowledge about environmental actors (Choudhury and Sampler, 1997). The organisations' structure acts both as means and obstacles to support information systems. In the context of scanning the environment, the organisation can act as an information filter (Wang et al., 1991), both positively and negatively. For instance, the following factors have been presented as critical : the structure of the scanning network (centralized versus decentralized) and the assignment of responsibilities ; the proactive versus reactive culture ; the management style ; the reward systems ; the existing information flows and their quality ; etc. Finally, information technologies constitute the last dimension of information processing capabilities an organisation dispose. It includes electronic, oral and written supports and in the context of information gathering, the relevant information technologies are those related to information accessibility, transmission, receipt, exchange and "transformation".

2.4. BI and the selection of weak signals : some limits

Before the implementation of specific information systems for business intelligence, some authors among whom Hedberg (1976, 1978) noted that organisations can not rely on "traditional" information systems to cope with environmental uncertainty. They had better consider them as potential obstacles since they tend to encourage inertia and leave anticipation issues to managers'

discretion, which has been revealed as not satisfactory. Actually, authors who have paid attention to individuals' information gathering strategies under time pressure and information overload are generally pessimistic about their abilities to anticipate strategic surprises (Kiesler and Sproull, 1982 ; Schwenk, 1984 ; Barr and al., 1992 ; Weick, 1995). For instance, Weick (1995) explains that uncertainty and complexity affect what people notice and ignore : they may simplify the cues that are extracted, they may implement queuing, filtering, abstracting, escape and chunking and finally alter the construction of the environment.

These individual weaknesses have motivated the creation of BI systems. The remaining questions are to assess whether they have overcome the preceding problems or created new ones and whether mechanisms to select EWS are proposed and satisfactory. A few authors formulate some general recommendations to improve the fit between information processing needs and information processing capabilities in the context of strategic intelligence systems. They can be grouped into two categories :

1. A general heuristic to improve individuals' information-processing capabilities (Mason and Mitroff, 1981 ; Cats-Baril and Huber, 1987) by providing them with knoweldge about BI.

2. A collective learning process to implement the heuristic (Hedberg et Jönsson, 1978 ; March and Feldman, 1981 ; Boland, 1994 ; Brannback, 1994) which implies to develop mechanisms of dialog and coordination such as direct supervision, standardization and mutual adjustment through informal communication within the environmental scanners' network (Gibbons and Prescott, 1996).

There is quite an important gap between these recommendations and existing BI systems regarding information gathering (Brannback, 1994 ; Lesca, 1994 ; Bartoli et Le Moigne, 1996 ; Vandenbosch and Huff, 1997). First, current research about BI ignore the problem of selecting EWS and focus on defining exhaustively and precisely information requirements. This is contrary to the nature of weak signals and often leads organisations to obtain "state-of-the-art" results (which tends to eliminate dissonant information) instead of proactive construction(s) of their environment. Actually, current research focus on information technologies, such as the Web, to support the gathering of BI information. It consists in increasing information-processing capabilities by increasing external raw data accessibility. This amounts to increase the information overload and do not enable organisations to reduce their uncertainty. As a response, some authors are currently developing methods to filter information but they keep on relying on the same postivist approach of information. They postulate that EWS can be found objectively into the environment thus ignoring the necessary interpretation process that permits to transform raw data into EWS.

To conclude, we can sum up BI limits regarding the information gathering mechanisms that are proposed as follows : the interpretation of raw data to

obtain EWS, which is an heuristic process relying largely on individuals' knowledge is not taken into account ; the collective dimension of the process on which lies the confrontation of individuals' points of view and which requires dialog and communication mechanisms has not been much evoked ; the collective learning process that is necessary to develop appropriate and effective organisational attention is ignored.

2.5. Research Question

Hence, it appears necessary to develop specific mechanisms, in the context of BI, to improve organisations' ability to select collectively EWS. We can formulate the following research question : What mechanisms to conceive in order to support the collective selection of weak signals in a business intelligence process ?

This question can be divided into two subquestions which are : what heuristic to propose ? what collective learning process to support the implementation of the heuristic ?

3. A SUPPORT TO SELECT EWS AND A FIELD STUDY

3.1. A general heuristic to select EWS

We present this method briefly as it is not really the purpose of this article.This heuristic is articulated around two constructs : the cognitive processes (which are heuristic) by which individuals select information ; the criteria and the categories to be used to prepare and to guide individuals' perception of EWS.

The heuristic must be : easy to implement as environmental scanners cannot afford and are not willing to spend much time on EWS selection ; quite general to fit various contexts and be refined in accordance with contextual factors. Nevertheless, it must also be discriminative enough to help people be selective.

The phases that we have retained are : perception of a potential EWS ; argumentation to transform the perceived piece of information into an EWS ; information evaluation in order to make it subsequently usable by other people and to incorporate it into existing representations of the environment.

After having identified dozens of information quality criteria, we have retained six of them which seem to be the most appropriate. Then, these remaining criteria have been defined and apportioned to the preceding phases. Hence, the perception of a potential EWS is guided by two criteria : information relevance

defined as its objective link to the BI scope (which supposes the existence of an explicit scope where actors are namely identified alongwith issues to be scrutinized and keywords) ; anticipative nature of information which is defined as its future-oriented nature and its ability to inform about future changes. The argumentation phase also relies on two indicative criteria which are : the significance of information which supposes that the individual formulates the future event he foresees ; the importance of this future event in terms of its potential impact on the organisation. Finally, the evaluation phase relies on two criteria which are information reliability depending on the information source and information timeliness which is the delay between information creation and information collection.

3.2. A collective learning process

The objective of implementing the heuristic through a collective learning process is to make individuals aware of their cognitive biases and of the collective dimension of the gathering process. However, before entering the collective learning, a training session to the constructs and concepts we propose is necessary (Vandenbosch and Huff, 1997). This 30 minutes preliminary session is articulated on three ideas which are the concept of BI, the environmental scanners' role and the heuristic and criteria that are being proposed.

Then, the collective learning phase begins. It includes two moments. First, people apply the heuristic on a case study which involves a BI scope, raw data and the users' guide accompanying the heuristic. Then, a collective work is initiated by a table lap where each persons says whether she has selected the information and argues his results. No commentaries from other persons are admitted. Then, a collective discussion takes place to argue individual differences. Finally, a collective "decision" about the selection of information is made and the experience about the heuristic is capitalized to be reusable. The next section presents our research methodology and a field study where we have implemented this heuristic. It illustrates the kind of knowledge we have produced.

3.3. Observing the selection of EWS : an action research

The proposed support (involving the heuristic and the collective learning process) has been implemented within various organisations willing to implement effective BI information gathering. These implementations have been done using an action research methodology. It has been made possible thanks to our support. These experiences allow us a preliminary validation of

our support and the deepening of scientific knowledge about BI and knowledge management. In the next section, we illustrate one of our experiences. Voluntarily, we emphasize observations related to the place of knowledge within BI.

Context of the experience : the organisation is a local unit of a big company from the telecommunications industry. The partnership with us has been initiated by the top executives who were willing to improve their BI process. They felt they suffer from both information overload and lack of strategic information. The group of participants is constituted of fifteen persons from various services and different hierarchical levels.

The training session lasted approximatively half an hour. Three points bring out from this phase of knowledge acquisition about BI. First, people feel all the more motivated by their environmental scanners' role as they understand both the structure of the information process and the role they have been assigned. Second, the concept of EWS is largely accepted and seems to match a kind of information they were not able to formalize before. The opportunity people had to give examples of EWS they had in mind seemed to relieve them of a burden. Nevertheless, the limits of the concept have rapidly been reached. The intrinsic ambiguity of EWS motivated both dilemma and suggestions. For instance, participants did not agree to say whether the following piece of information *"our main competitor has just opened a distribution center downtown"* is an EWS. Another participant suggested to create an open list of EWS to support imagination. Finally, these difficulties introduced the need for a method. The presentation of our support has been well accepted. Even people who dread that this training would be complicated felt positively suprised by both its usability and its utility.

The next phase consists in observing the participants selecting information by applying the support. Individuals are provided with a BI scope and raw data and achieve their own selections. This lasts about twenty minutes. Only two persons did not carry out the exercise. One felt she had not enough expertise with regard to the other participants and concerning the domain under study. The other told us that this work was too unprecise and ambiguous.

Then we started the table lap. Each argumentation is written on the board in a way that highlights differences. Results are quite suprising as people's points of view are often very different.

At the end of these individual presentation, the collective discussion is very rapidly engaged by persons willing to compare their argumentation to others. Once engaged, we organized this phase in accordance with the selection process. We present here the main commentaries as they have been stated :

<u>Commentaries about information relevance :</u>

"According to me, this piece of information is not related to the BI scope. But I think the reason is that I did not understand this issue as you did."

"There is no need to be an expert to identify a link between a piece of information and the BI scope. It is just key-word matching."

"Had I not known that this actor is a subsidiary of one that pertains our scope, and that he is very active abroad, I would not have selected that information."

Differences in the interpretation of the BI scope led us to define it again. Then, reaching a consensus about information relevance was quite easy.

Commentaries about anticipation and significance : One of the dialog between two participants is quite illustrative of the way this criterion has been treated.

D :"I don't agree with you. This is not anticipative but rather a passed event !"

V :"Of course it is anticipative. Don't you think that this action indicates a future offensive towards our customers. The main point is that they are gathering information about our own customers and their satisfaction about our products."

D : "I had not seen that action under this commercial point of view. But now, I do agree with you and I would select this piece of informatio nto the extent that your argumentation is added to the raw data."

Commentaries about the importance criterion : This criterion has raised animated discussions. Three representative commentaries are given :

"I would have enjoyed to share the point of view of persons from the marketing department about these future products."

"This criteria is very important for us. It allows us to reveal and to share our individual richness. "

"I don't know much about our customers information systems. I wonder whether we are able to do as this competitor. I thought we were able and you do not seem to agree. So ?

Commentaries about information reliability and timeliness : A few remarks have been formulated. People were not really preoccupied by these criteria and the differences they have uncover. Among the most "sophisticated" commentaries, we have noted the following ones :

"This piece of information, whatever the source it comes from, is not very reliable. The reason is that the picture do not match what is described in the text".

"Timeliness is important but it is rather difficult to assess."

"I knew that informatioin already. So, I don't think its timeliness is high."

"How to know how long a piece of information has been kept by a journalist without being published".

After reviewing the six criteria, the discussion is recapitulated on the board in order to highlight the way the heuristic has been actually used and the final decision for each piece of information. We have carefully noted the remaining differences between individuals. At the end of this collective learning, participants have given their point of view about the whole session.

4. RESULTS

As action research has both practical and theoretical objectives, we articulate the presentation of our results around these two dimensions. A special emphasis is given knowledge.

4.1. Practical results : knowledge management issues and BI

The proposed support has been largely accepted and perceived as both usable and useful. The training session has allowed participants to understand their information processing difficulties and to improve their knowledge about BI. They have recognized that it has increase their motivation to track down information, and that they felt the task as potentially less difficult.

The collective learning process has been perceived as useful for various reasons. First, it is a way to be more effective as procedural knowledge (how to select information) has been acquired. Moreover, individuals have become aware of their own biases, due to their own knowledge, which tends to favor a collective behavior. People need to share information and knowledge to enhance mutual enrichment instead of keeping a partial representation of their environmnent. This awareness is a positive factor to motivate and to enable individuals to explicit their implicit knowledge. Finally, the procedural knowledge they have acquired is intended to evolve as suggested by the participants themselves.

A major point in the utility of the heuristic lies in the notions of anticipation and significance. These criteria bring added value to the process as they imply that knowledge is integrated into the selection process. Enrichment is quite easy as even when people initially diverge about one piece of information, a consensus is rapidly established. Nevertheless, the lack of familiarity in using such criteria may act as an obstacle, some persons thinking that it is too selective. So, more practical knowledge is required here.

4.2. Theoretical resutls : relationships between knowledge and EWS selection

First, as Vandenbosch and Huff (1997) suggested, it appears necessary to train people to the concepts and constructs they will have to implement. The development of preliminary knowledge is a necessary condition for the environmental scanners' network to be motivated and effective, that is to say to fit the information processing needs.

Second, prior knowledge in the form of expertise, privileged relationships with the environment, but also organisational position, affects the use of the proposed criteria. Individuals do feel guided and more effective in their information selection thanks to the heuristic. Nevertheless, as Kiesler and Sproull (1982) suggested, cognitive biases also apply to the use of criteria. For instance, information relevance depends on the knowledge individuals have about actors and issues of the BI scope. We have also observed that some people judge information as not relevant just because it does not enter their specific domain of expertise as mentioned by Choudhury and Sampler (1997) or because of their organisational position as mentioned by Cowan (1986) and Walsh (1988). Hence, prior knowledge may act as an important obstacles to EWS selection.

Concerning the anticipation and significance of information, the willingness to use these criteria depends on individuals' tolerance for ambiguity (Dermer, 1973). The way people use them is intrinsically linked to their knowledge and leads to different points of view about a same piece of information. This shows that EWS is necessarily constructed through interpretation and that this process needs to be guided and supported by appropriate information support.

The collective learning process we have proposed has also allowed people to become aware of their own biases due to their own knowledge. This has been possible by rendering individual tacit knowledge both collective and explicit. A major consequence is that individual become aware that their knowledge about the environment but also about information processing may evolve thanks to mutual enrichment.

5. CONCLUSION

To conclude, we can state that EWS can not be approached objectively but rather as a construct that implies individuals' knowledge. Hence, the selection process should necessarily be contemplated as a collective process where interpretation plays a major role. This leads us to formulate both practical and theoretical implications.

First, improving scanners' knowledge about BI, their role and the "procedures" they should implement increases their consciousness about BI and their motivation. So, developing scanners knowledge about BI seems to be an effective way to overcome the barriers identified by Boettcher and Welge (1994). In accordance with this standpoint, we have conceived a didactic software that is currently being tested.

Another interesting phenomenon lies in the necessity to manage prior knowledge in order to improve the selection process. This knowledge management has different levels. First, a kind of knowledge cartography inside the organisation should be established to ensure that the BI scope is covered by the selected environmental scanners. Some redundance may be enhanced to avoid prior knowledge biases in the selection process. Second, interpreting raw data to obtain EWS is perceived as adding value thus motivating. Moreover, participants feel that it is an opportunity to make the organisation benefit from their individual knowledge. So, specific supports and mechanisms should be implemented in order to make this implicit knowledge become explicit and collective. Finally, as people become aware of their own biases in part due to their specific knowledge, they feel that feedback loops should be possible to favor mutual enrichment. Moreover, they wish to organize periodic collective learning sessions in order to refine the heuristic and to enhance mutual adjustments. Such mechanisms should also be supported by the BI process.

Practically, the organisation we have worked with has listed each scanners' addresses, phone and fax numbers, designed a special "journal" to animate the network and organized periodic meetings. This amounts to develop a relational system between environmental scanners to support coordination and mutual enrichment. Furthermore, redundancy between scanners in terms of knowledge as well as network evolutivity should be allowed thanks to specific mechanisms.

Of course we are aware of the limits of this research in terms of generalization of our results. Nevertheless, we have replicated this experience within various organisations and we are about to explore new research avenues. Some of them concern validity conditions of the implementation of our support. For instance, we plan to replicate the experience presented here in a research community and a multinational group.

6. REFERENCES

Aaker, D.A. (1983). Organizing a strategic information system. California Management Review 25(2) 73-83.

Ansoff I. (1975). Managing strategic surprise by response to weak signals. California Management Review, 18(2) 21-33.

Ansoff, H.I, Eppink, J., Gomer, H. (1979). Management of strategic surprise and discontinuity : problem of managerial decisiveness. *Economies et Sociétés*, G.1 459-488.

Barr P.S., Stimpert J.L., Huff A.S.(1992). Cognitive change, strategic action, and organizational renewal. Strategic Management Journal 13 15-36.

Bartoli J.A et Le Moigne J.L. (1996). Organisation intelligente et système d'information stratégique. Paris, Ed. Economica.

Belkin N.J., Croft W.B. (1992). Information filtering and information retrieval : two sides of the same coin ? Communication of the ACM 35(12) 29-38.

Cyert, R.M. and March, J.G. (1963). A behavioral theroy of the firm. Englewood Cliffs : NJ.

Billings R.S., Milburn T.W., Schaalman M.L. (1980). A model of crisis perception : a theoretical and empirical analysis. Administrative Science Quarterly 25 300-316.

Boettcher R., Welge M.K. (1994). Strategic information diagnosis in the global organization. Marketing International Journal 34(1) 7-24.

Boland R.J., Tenkasi R.V., Te'eni D. (1994). Designing information technology to support distributed cognition. Organization Science 5(3) 456-475.

Brannback M. (1994). Decision support systems for strategic management. Journal of Decision Systems 3(2) 95-114.

Bright, J.R. (1970). Evaluating signals of technological change. Harvard Business Review January 62-70.

Cats-Baril W., Huber G. (1987). Decision support systems for ill-structured problems : an empirical study. Decision Sciences 18 350-373.

Choudhury V., Sampler J.L. (1997). Information specificity and environmental scanning : an economic perspective. Management Information Systems Quarterly 21(1) 25-53.

Cowan D.A. (1986). Developing a process model of problem recognition. Academy of Management Review 11(4) 63-776.

Daft R.L., Sormunen J., Parks D. (1988). Chief executives scanning environmental charracteristics and company performance : an empirical study. Strategic Management Journal 9 123-139.

Daft R.L., Weick K.E. (1984). Toward a model of organizations as interpretation systems. Academy of Management Review 9(2) 284-295.

Dermer J.D. (1973). Cognitive characteristics and the perceived importance of information. The Accounting Review 48 511-519.

Galbraith J. (1973). Designing complex organizations. Addison-Wesley.

Gibbons P.T., Prescott J.E. (1996). Parallel competitive intelligence processes in organisations. International Journal of Technology Management, Special Issue on Informal Information Flow 11(1/2) 162-178.

Gilad B and Gilad T. (1988). The business intelligence system : a new tool for competitive advantage. Amacom 1988.

Hambrick D.C. (1982). Environmental scanning and organizational strategy. Strategic Management Journal 3 159-174.

Hedberg B.L.T., Nystrom P.C., Starbuck W.H. (1976). Camping on seesaws : prescriptions for a self-designing organizations. Administrative Science Quarterly 21 march 41-65.

Hedberg B., Jönsson S. (1978). Designing semi-confusing IS for organizations in changing environments. Accounting , Organizations and Society.

Johnson-Laird P.N. (1983). Mental models. Harvard University Press : Cambridge.

Keen P.G.W. and Scott-Morton M.S. (1978). Decision support systems : an organizational perspective. Addison Wesley Ed.

Kiesler S., Sproull L. (1982). Managerial response to changing environments perception on problem-sensing from social cognition. Administrative Science Quarterly 27 548-570.

Lesca H. (1994). Veille stratégique pour le management stratégique de l'entreprise. Economies et Sociétés, Série Sciences de Gestion, SG20(5) 31-50.

March G.J., Feldman M. (1981). Information in organizations as signal and symbol. Administrative Science Quarterly 26 171-186.

Mason R., Mitroff I.I. (1981). Challenging strategic planning assumption. Wiley :NY.

Mintzberg H., Raisinghani S et Théorêt A. (1976). The structure of unstructured decision processes. Administrative Science Quarterly 21(2) 246-275.

O'Reilly C.A. (1980) .Individuals and information overload in organizations : is more necessarily better ?. Academy of Management Journal 23(4) 684-696.

Porter M.E. (1980). Competitive Strategy. New York, Free Press.

Reinhardt, W.A. (1984). An early warning system for strategic planning. Long Range Planning, 17(5) 25-34.

Schwenk C.R. (1984). Cognitive simplification processes in strategic decision making. Strategic Management Journal 5 111-128.

Simon H. (1977). The new science of management decision. Prentice Hall, Revised edition.

Smircich L., Stubbart C. (1985). Strategic management in an enacted world. Academy of Management Review 10(4) 724-736.

Thiétart R.A., Vivas R. (1981). Strategic intelligence activity : the management of the sales force as a source of strategic information. Strategic Management Journal. 2.

Thomas, J.B., Clark, S.M., Gioia, D.A. (1993). Strategic sensemaking and organizational performance : linkages among scanning, interpretation, action and outcomes. Academy of Management Journal 36(2) 239-270.

Vandenbosch B., Huff S.L. (1997). Searching and scanning : how executives obtain information from executives information systems. Management Information Systems Quarterly 21(1) 81-107.

Weick K.E. (1995). Sensemaking in organizations. Sage Publications.

Walsh J.P. (1988). Selectivity and selective perception : an investigation of managers' belief structures and information processing. Academy of Management Journal 31 873-896.

Wang P. et al. (1991). Filtering strategic environmental information processing using EIS. Proceedings of the 27th IEEE Conference on System Science 3 126-134.