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Introduction

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The Journal of Competitive Intelligence and Management (JCIM) is a quarterly, international, blind refereed journal edited under the auspices of the Society of Competitive Intelligence Professionals (SCIP). JCIM is the premier voice of the Competitive Intelligence (CI) profession and the main venue for scholarly material covering all aspects of the CI and management field. Its primary aim is to further the development and professionalization of CI and to encourage greater understanding of the management of competition by publishing original, high quality, scholarly material in an easily readable format with an eye toward practical applications.

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Developing Capabilities to Create Collective Intelligence within Organizations

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Executive Summary

Although Business Intelligence (BI) is perceived as being more and more essential to the survival of organizations, its viability and effectiveness can be questioned in terms of the inability of practitioners to exploit strategic information. As little work is available on this practical issue, our objective is to fill the gap by developing a method for the creation of collective intelligence on organizational environments. Using a qualitative methodology known as 'engineering management research', we have attempted to further both practical and theoretical knowledge about BI. So far, we have completed four experiments within organizations. The theoretical as well as the practical results are encouraging. In this article we have attempted to present our approach in a way that may be of value to people interested in applying it themselves.

Key Words:

Business Intelligence, exploitation of strategic information, collective intelligence, engineering management research

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Introduction

Business Intelligence (BI) can be defined as "the information process through which companies prospectively monitor their environment in order to create opportunities and to reduce their uncertainty" (Lesca, 1994). On the basis of this definition, three main statements may be made about BI.

First, as a strategic decision support tool designed for anticipation purposes, BI deals with non-routine and unique decisions. Bounded rationality and approximate reasoning are therefore unavoidable to process information which restricts possibilities for implementing algorithm-based and expert systems approaches. More specifically, BI may be included in the intelligence stage of organizational and individual decision-making processes as formulated by Simon (1982). It therefore involves a stage for information search, interpretation and vision building rather than the implementation of rational models.

Secondly, the forward-looking nature of BI implies a focus on anticipatory information - what Ansoff (1975) called weak signals. Their main features are 1) no intrinsic relevance and 2) no possible definition in advance (Feldman & March, 1981) as to either the content or the source of information. These two features make it difficult to process this kind of information and may lead people to ignore it. Finally, BI is an information gathering process that can be linked to an iterative learning process of which the main steps are described in Figure 1 below.

A major problem in the field BI lies in the confrontation between researchers' assertions on how to perform BI and practitioners' difficulties and lack of ability in implementing it. The purpose of this article is to shed light on one of these difficulties: the use of weak signals to identify potential threats and opportunities and to heighten the understanding of the probable future.

To do so, we shall first formulate explanations of these difficulties and use them to build up a conceptual approach to help practitioners in situation. We shall then describe the instrumentation and practical implementation of this approach within organizations. In doing so, we shall underline the major methodological issues so that our experience may be reproduced by researchers and practitioners. We have tried to make sure that the prerequisites and conditions of implementation are observed. Finally, we have presented both practical and methodological contributions.

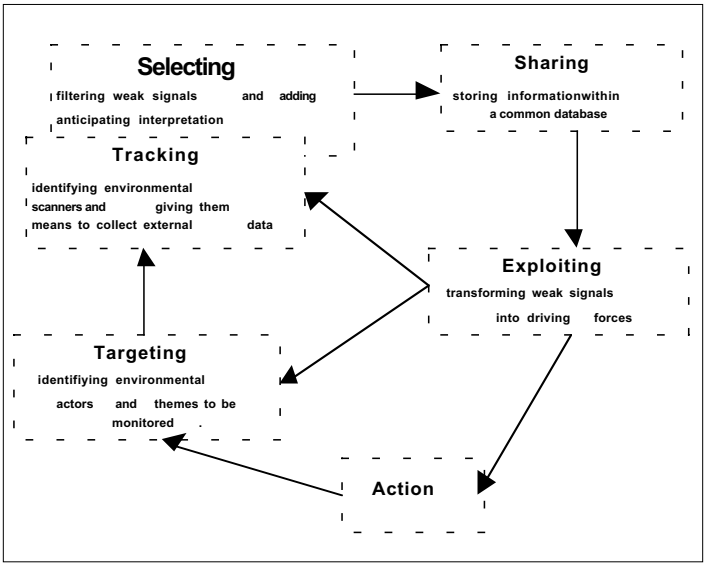

Figure 1: The BI Process

Table 1
Nature of Weak Signals and Consequences of their Use

Nature of Weak Signals	Consequences for Their Analysis
Anticipatory	Weak signals are related to potential future events that may affect the organization. They must forewarn managers early enough for reaction to be possible. Hence, each signal does not have much significance in itself and is quite difficult to relate to immediate decisions to be taken.
Qualitative	Weak signals are not numbers with records, or extrapolations. They are related to potential events that have not yet occured and may never occur. Therefore, signals that alert to future events can not consist of either quantitative or factual data.
Ambiguous	Weak signals do not consist of certainties but of clues and traces. They can be interpreted in different ways with no possibility of identifying the right interpretation or they cannot be interpreted at all.Therefore, they are not easily captured.
Fragmentary	Weak signals are present in the form of fragments which have been patiently collected and gathered by various environmental scanners. Taken separately, each fragment is insignificant and suspect. Hence, significance can only be achieved by patient cross-checking. It is a gradual process.
Of Various Presentations	Pieces of information may be picked up in any shape or form, such as snatches of conversation, electronic data, messages from conferences and so on. . . . As they are not homogenous, their exploitation is all the more difficult.

Background and Purpose

Paradox between Theory and Practice

Regarding BI, the gap between theory and practice is wide. According to management theory, managers know and are capable of assessing changes in their socio-economic environment to seize opportunities as they arise. In practice, managers do not rely very much on anticipatory information. Our work is grounded in the gap between theory and practice. The following case illustrates something of the paradox observed in companies:

> "Sometimes, my colleagues urge me to consider pieces of information they have just captured. The problem is that I am overwhelmed by information and their pieces of information rarely fall into my immediate worries. Hence, I leave them aside for the time being and when those pieces of information are finally required, I can seldom retrieve them. It is often too late when I come to understand that they were surely strategic pieces of information."
>
> *- Director of a medium-size company*

According to observations collected during our field experiences, this situation occurs frequently in companies. The problem is that relevant weak signals are seldom exploited afterwards because they are no longer accessible when they are needed and require

crosschecking to gain significance. We believe that the intrinsic nature of weak signals (Ansoff, 1975; Feldman & March, 1981; Lesca 1992; and Table 1) largely accounts for the paradox mentioned above. Finally, our research leads us to conclude that methods are lacking to help managers process strategic information.

Assumptions, Inference and Purpose of this Paper

Assumptions

It is probably because weak signals captured by environmental scanners have no immediate use and no obvious significance that managers perceive their exploitation as being difficult. They would prefer to receive weak signals in an appropriate form just when needed. However, since no methods are available, managers fail to exploit weak signals and therefore BI viability is often questioned within organizations because no anticipatory and action-oriented representations of the environment are achieved.

Inference

If our assumptions are correct, there should be general acceptance from most managers of a method to analyze pieces of information and produce meaning, both individually and collectively, even when there is no rush to solve a problem or to make a decision.

Purpose of this Paper

The aim of this paper is to try to reduce the gap we have identified by designing a new BI method and implement it within several organizations. Feedback from the experiments is provided, and emphasis is given to the utility and the practicability of the method.

Draft of a Method to Produce Collective Intelligence from Weak Signals

According to Gorry and Scott-Morton (1971), a feature that is lacking in information systems is their inability to develop models that reflect the way managers see their organization and their environment. Understanding manager's cognitive process is supposed to be an essential condition for the design of an effective decision support system (Gorry & Scott-Morton, 1971; Rowe & Ziti, 2000). We agree with this point of view and take it as one of our assumptions. Consequently, we accept that progress in BI information handling could be achieved by relying on human cognitive process.

Many authors (Miller, 1956; Mintzberg, 1976; Goldhar, Bragaw & Schwarts, 1976; Taggart & Robey, 1981) have tried to represent human cognitive processes. Two main ideas are emerging from their models: 1) the regrouping of information and 2) the creation of links between pieces of information. We shall argue both ideas in the following section.

Regrouping Pieces of Information

McKenney and Keen (1974) have proposed a model to describe the way people structure information (either oral or visual) which has been captured in their environment. They suggest the use of a regrouping process. But the way this regrouping is performed needs to be specified.

Weber (1984) also analyzed the human cognitive process related to regrouping. When faced with ambiguous situations, people try to build meaningful representations of their environment by placing pieces of information side by side and grouping them together.

Again, the regrouping method has to be specified. Therefore, we underline the need to formulate assignment criteria enabling new pieces of information to be classified easily into existing or new groups under everyday pressure. These criteria must be usable, both individually and collectively, and explicitly communicable to others in order to create collective intelligence. Two criteria have been mentioned in the relevant literature:

Similarity Criterion

Pieces of information can be grouped by similarity. We try to connect similar information whether it expresses the same idea or relates to the same theme. Kawakita-Jiro (in Hogarth, 1980) uses this criterion. Each piece of information is assigned to the group with which there is a link. Users then find they are

dealing with small groups of information that can be handled separately.

According to Moles (1990), when somebody is confronted with a " sketchy set of ill-matched elements ", she/he tries to find some similarity between these elements. When faced with a new piece of information, people try to find some similarity with an existing group (Conklin, 1987). Behling, Gifford and Tolliver (1980) have proposed a method to connect a piece of information with a group. Pieces of information are assigned to a group if they have common characteristics with this group, so that each new piece of information, whether perceived or received, can be analyzed. After this, the information will either be rejected or assigned to a group. In the box illustrating the regrouping of pieces of information, they are placed side by side in non-particular order, at least to begin with (Weber, 1984).

Proximity Criterion

This criterion is less restrictive than the first, but also more approximate. One way of assigning pieces of information to an existing group is to use the proximity criterion. 'Proximity' means that information seems close to the theme it will be connected to. Recognition of a common characteristic is a proximity criterion. Pieces of information may be quite different, but individuals can bring them closer by using a common point of view. According to Moles (1990), this assignment can be done easily because it is natural: when faced with a new piece of information, people include it in an appropriate existing group because they sense its proximity. This is a subjective process and is probably done when taking into account a major individual preoccupation. But when they process the most familiar signals, people are not careful enough about other signals that announce changes (Barr, Stimpert & Huff, 1992). Hence there is a risk of biases arising from subjectivity. This risk is reduced if regrouping is done collectively.

Once this first step is completed, pieces of information are put together, side by side in no particular order at least to begin with. But completing this stage does not in itself produce useful meaning. A second stage is therefore necessary to show how pieces of information are connected.

Connecting Pieces of Information Within and Between Groups

Another step can be completed by creating connections between pieces of information within and among existing groups. Kawakita-Jiro (in Hogarth, 1980) has proposed a creative technique to build significant structures, from unconnected pieces of information at the moment when they are gathered. The basic idea of this technique involves interconnecting pieces of information in each group. The author specifies that each piece of information has to be compared to the others and matched in order to produce a significant construct for users.

Lee and Lai (1991) have proposed seven types of links: the logically implied link, the support link, the denial link, the qualifying link, the presupposition link, the object to link and the answer link. We shall deal with some of these links calling them by their most common name.

The 'Causality Link' and the 'Influence Link'

Bougon, Weick and Binkhorst (1977) have shown, through an observation study, that individuals use causality connections to classify knowledge in their minds. Information A is connected to information B if A is the cause of B. In fact, causality is the most common link used by authors such as Barr, Stimpert and Huff (1992), Narayanan and Fahey (1990), Laroche and Nioche (1994) for example.

Causality relations are very interesting because they are really meaningful. But this assumes that the problem is already solved and that the set of pieces of information to be used in the causality chain have been identified. This is not the case in the field of strategic observation. In fact:

- The chain is made up of only a few pieces of information (incomplete information)
- The pieces of information are not ordered: we have a cause without its effects or an effect without its causes.

The causality relation may be considered as an ideal situation that is probably unachievable and probably inaccessible, especially under daily pressure and with limited means. We therefore have to find

another solution which is why have chosen to consider more 'soft' connections that are undoubtedly more usable in this case.

This fits with the so-called " influence link " (Roos & Hall, 1980). In this case, information A is connected to information B if A has influence on B, without considering A as the single cause of B and without requiring A to be the direct and single cause of B. This type of link has been used many times (Lesca, 1989).

The "Object To" Link

When they are faced with inaccurate and ambiguous data, and unable to make connections using causality or influence links, individuals may try to oppose them. This dialectic has been analyzed by theorists in psychology. They state that people are better able to understand the opposition or difference between two concepts than each piece of information taken separately (Moles, 1990). Lee and Lai (1991) propose this type of relation seeing it as effective way of drawing meaning from raw information. The SIBYL software uses opposition relation to support group decision making (Lee, 1990). In the BI field, where the process deals with signals that are forerunners of changes, the relation of opposition could be used to bring out inconsistencies or incoherence between pieces of information that have been grouped together. It is critical to note that, whatever the type of link we choose to create meaning from disparate pieces of information, a difficult problem has to be solved: how to set up the choice of a link between two pieces of information?

The "Confirm To" Link

According to Hunt and Zartarian (1990), one of the best ways of assessing the credibility of weak signals is to seek reciprocal confirmation. To illustrate their idea, the authors propose the following situation. When you learn, both from a client and a supplier, that one of your competitors is preparing to launch a new product, you can consider the piece of information as certain. Unfortunately, pieces of information handled by managers do not come from various sources, especially data which are very new. In such cases, managers have to create potential links between pieces of information in order to decide whether mutual confirmation is possible. The "Confirm to" link allows managers to evaluate the credibility and accuracy of pieces of information, and enables them to transform weak signals into more reliable information.

Skeleton and Set Up of the Suggested Method

We can now sum up our knowledge and incorporate it into a method to create collective intelligence on the environment of an organization (see Figure 2).

We could have chosen to instrumentalize the method using a software support tool, but we prefer the 'paper method' to evaluate theoretical proposals only. We chose to avoid all interference arising from the use and the acceptance of IT. Furthermore, our field experiences show that, in the early stage of implementation, the use of IT tends to be perceived as too rigid and constraining, especially in small and medium size firms.

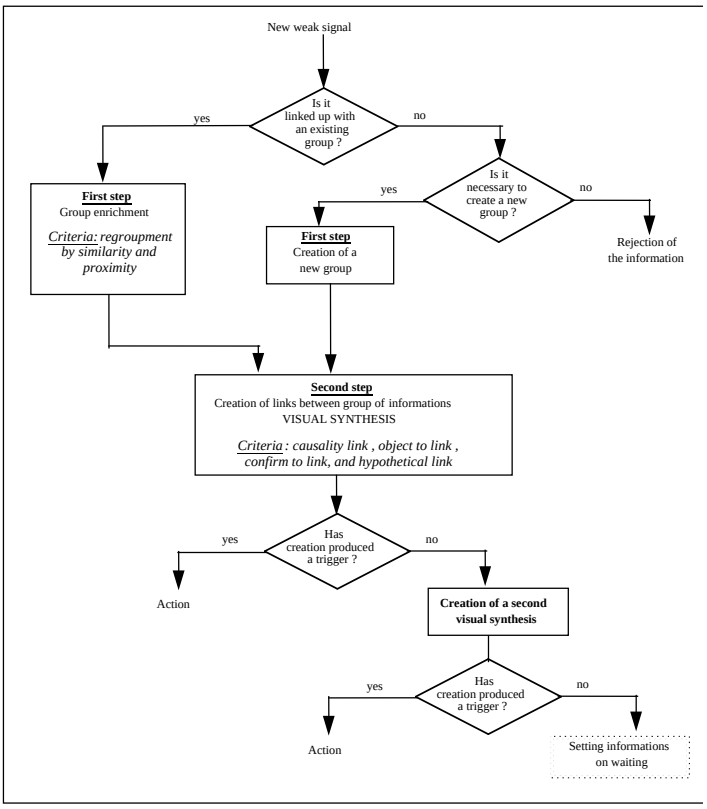

Figure 2: Creative Collective Intelligence Process: A Conceptual Model

Research Approach

To some extent, our research methodology is similar to action research in the sense we have attempted to produce results of practical value to organizations with which we are allied while at the same time adding to theoretical knowledge and gaining expertise. This approach can therefore be useful both to practitioners hoping to implement or improve BI in their organization and to researchers seeking a better understanding of BI.

Another important point in our approach is the building of tools as in an engineering approach. These tools are contributing to enrich a 'BI technological platform' or 'BI tool kit' thus enabling the evolution of BI. This approach gives practitioners the means to tackle BI issues and enable researchers to observe the BI process in details and to collect data on the way BI is performed. This research can be compared to "systemic action research" or evolutive research as understood by Myer and Avison (2001).

Prerequisites for the Implementation of Management Engineering Approach

Before engaging in this kind of engineering work, we need to address the following points:

- *Nature of the problem* : complex and poorly structured, arising from field observations and never previously addressed
- *Type of knowledge to be produced*: the aim of the work should include the building of methods and tools to further BI performance. This knowledge should provide useful representations and insights into the BI process to support action and improve conceptual and theoretical knowledge

Stages in Implementation of Management Engineering Research

The starting point is the existence of a gap between empirical problems and scientific literature. The need for greater intelligibility regarding both the literature and concrete situations has led us to design a theoretical model of the process. The engineering aspect of the methodology consists in building a method - i.e. a prototype of our model - in order to implement it within organizations and enable us to make relevant observations. The method, with its user guide, is then tested within organizations in order to: 1) improve the situation from the practitioners' standpoint and 2) collect data on what is satisfactory or unsatisfactory in the new method. This contributes to an empirical validation of theoretical assumptions and managerial beliefs. Figure 3 depicts a schematic representation of this management engineering approach.

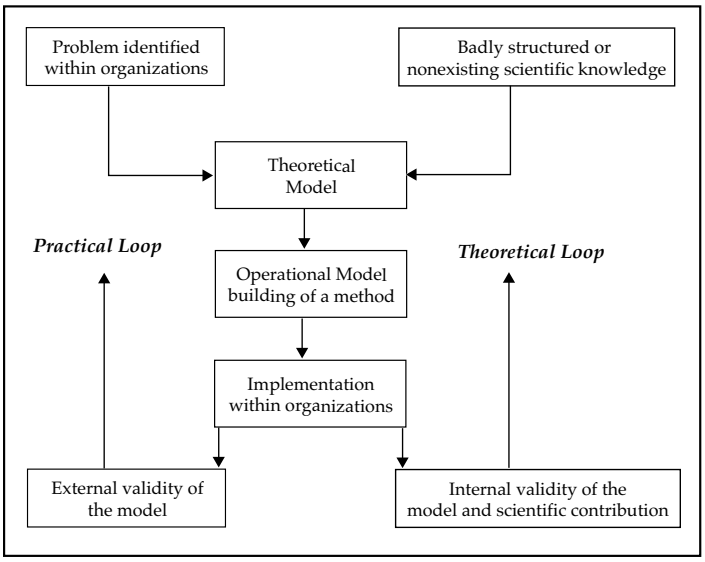

Figure 3: Stages in Management Engineering Research

Implementation within organizations lasts at least for a few months and focuses on the identification of a problematical situation, explaining it, and developing a 'solution'. This broad-based collaboration is akin to participatory action research (Whyte, 1991).

Criteria for Assessing Experiments

The results that need to be brought out to assess the work achieved are at once diverse and complementary as shown below:

- *Intelligibility* of a complex process and ability to gain a satisfactory image of it
- *Support* for the understanding of a problematical situation
- *Comprehensibility* and *usability* of theoretical concepts presented in the support method and *articulation* of disparate theoretical knowledge

Table 2
Major Contributions of Our Research

Expected Contributions	Theoretical Contributions
Cognitive Process for the Exploitation of Strategic Information	• Managers have a tendency to process weak signals holistically • Managers have tendency to regroup pieces of information by subject • The causality link is not suited to the process of strategic information • Managers take the reliability of strategic information into account • Linking pieces of information is useful for processing weak signals but managers perceive this as a difficult task.
Business Intelligence Process	• Our results confirm that BI is perceived as a complex process. Managers perceived it as difficult to implement and organize. • Our results confirm that BI is an iterative process with feedback loops. Analyses of strategic information must induce firms into taking strategic decisions, but can also lead them to modify the targeting stage.
Conditions for Strategic Information Processing	• Processing of weak signals must be done by experts • Processing of weak signals is effective only if the firm has formalized the targeting, tracking, selecting and circulation stages.
Practicability of the Method	• The method enables managers to process weak signals and to create visual synthesis. The proposed criteria seem to be adequate and easy to use.
Utility of the Method	• The method enables firms to progress in the processing of weak signals and at the same time in the creation of visual synthesis to support strategic decisions.

- *Identification* of hypotheses to allow the model to be generalized and the approach to be reproduced.

Implementation of the Conceptual Model

First, it should be noted that the internal validity of our conceptual model has been validated through laboratory experiments. After further refining, the model was implemented within organizations.

Data Sources

For this article, we worked with four medium-sized companies. A necessary criterion to undertake work with them was the perception by BI practitioners of difficulties in analyzing weak signals. These four companies operate within turbulent environments such as telecommunications, microelectronics, and banking which explains their interest in BI. Each collaboration lasted six months on average.

Design for Data Collection

To meet our objectives, data collection relies largely on sessions calling on a collective learning process. The process has four stages (Davis & Olson, 1995): raising awareness, individual learning, recommendations, and validation. Between each collective learn-

ing session (once a month), people used the proposed method on an ongoing basis to assess its usability and usefulness. Their remarks were collected for analysis during the next collective session. The method can thus be collectively refined and worked out in more depth according to the specific features of each organization.

Procedures and Means for Collecting and Recording Data

At least two researchers were present during the collective session, one to run the support method and the other to collect data through direct observations. A data collection grid was provided for the observer. This was in the form of a knowledge database (appropriateness of tackled concepts, level of understanding by practitioners, articulation of concepts) and included observations on theoretical concepts presented in the support method:

- assessment of the model (relevance of the conceptual model to empirical situations, identification of strengths and weaknesses of the model)
- assessment of the support tool and research method (perceived satisfaction and utility, validity of data collection using the tool, potential improvements, perceived completion of each stage in the research method)

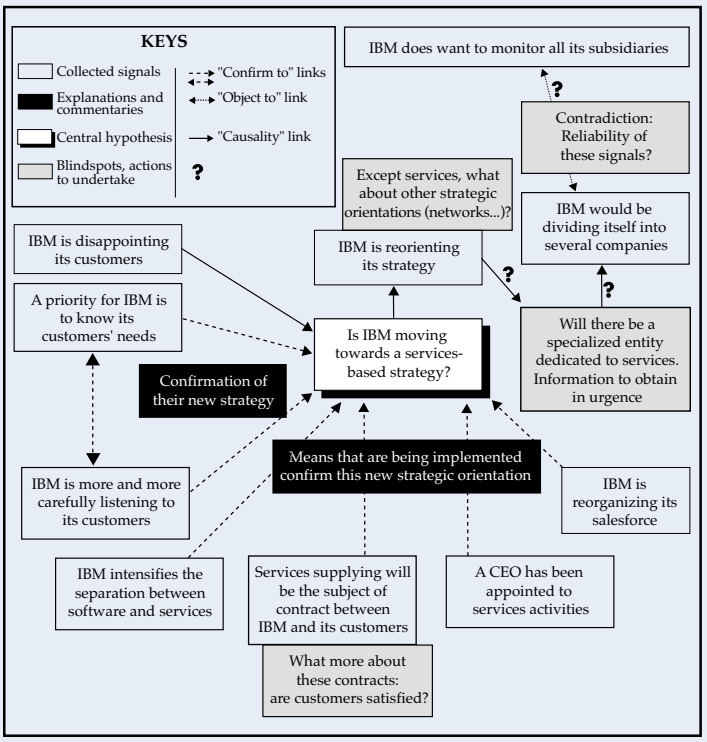

Figure 4: Example of a Meaningful Representation of the Environment

Findings and Contributions

Findings: Creating Collective Business Intelligence

Our findings highlight the need for a method, the overall satisfaction and usefulness of our prototype, and the ability to achieve meaningful and anticipatory representations of organizations' environments. Figure 4 illustrates the concept of meaningful representation.

With regards to Figure 4, our research team was interested in IBM and its possible strategy regarding service activities. We collected 11 potentially interesting weak signals in order to build a meaningful representation of IBM's services policy to gain better understanding of its strategy. The central idea of the representation is in the form of a question: "Is IBM moving towards a service based strategy?"

Two weak signals ('IBM is disappointing its customers' and 'IBM is reorienting its strategy') allowed us through a causality link to validate the idea that IBM has indeed decided on a strategic shift towards services. We then tried to confirm the new policy by looking to see whether IBM had given itself the means to pursue this new policy.

The use of confirmation links enabled us to confirm that IBM is profoundly motivated in favor of a shift towards services. For example, it has engaged a CEO for services ('a CEO has been appointed to service activities') and has tried to change its structure ('IBM intensifies the division between software and services').

Some contradictions have appeared like IBM's policy of increasing its control over its subsidiaries and its moves to restructure itself as multiple companies. Due to this contradiction, it was consequently appropriate to check the reliability of these two pieces of information. It was also necessary to eliminate the contradiction by adding new information. The use of

the hypothetical causality link brought new questions to light, which were usefully informed by the contribution of new pieces of information or weak signals.

To conclude, the method made it possible to answer part of our question by bringing in elements of confirmation. However, a number of contradictions appeared leading us to seek new information. Some analyses and comments also call for further information.

Practical and Theoretical Contributions

For easier comparison between expected and actual contributions, we have presented our main contributions in tabular form (see Table 2).

Detailed Results on the Utility and Practicality of the Method

Utility of the Method

Of all the practitioners who were interviewed, only two reacted unfavorably to the method. The first thought that the method was not useful for the company because its environment was not particularly complex and could easily be understood without a specific method. The second practitioner criticized the contribution of a method that does not start from the *beginning* of the BI process. He was bothered by the fact that the method contributes to the exploitation of information without explaining how it was collected and circulated.

The observations from the other practitioners make it possible to come to a favorable conclusion as to the acceptability of the method:

- It implements a natural way of working. It proposes, but in a more formalized way, an intuitive way of working
- The method is perceived as a factor of progress in that it formalizes a complex process
- It allows knowledge to be confronted and especially offers real help in exploiting weak signals
- It offers true solution to the lack of know-how among practitioners
- One of the practitioners stressed that the method offers a support tool for the organization and helps to dynamize the whole BI process
- Finally, presenting the information in the form of a visual synthesis seems to be useful as all the information can be shown on the same support, which make it easier to interpret

In short, the results obtained from the practitioners validate our production to some extent as well as the assumptions made regarding acceptance by managers if a method for the exploitation of strategic information like weak signals were proposed to them.

Praticality of the Method

Stage 1: Regrouping Pieces of Information:

Our experiments with companies make it possible to validate the phase of regrouping pieces of information as well as the relevance of the suggested criteria, which seem to have been accepted quite naturally by the practitioners. Some of them even found them perfectly obvious. Moreover, some companies acknowledged that they were already using these criteria to exploit their information.

Stage 2: Connecting Pieces of Information:

The managers thought that the method made the task of connecting pieces of information easier. In particular, the written form of the suggested links gained widespread approval among the practitioners, who thought that this helped to make fast comparisons between pieces of information and to interpret representations during subsequent consultations.

This stage also made it possible to validate information and to reflect on the real relationships between pieces of information. It helped to take their ambiguous nature into account.

The visual presentation of the information as well as the written form of the links had the advantage of providing a visual synthesis that could be readily understood, interpreted and communicated. The practitioners were attracted by the holistic reading of representations: they could quickly and easily recon-

stitute and understand the reasoning from which the synthesis was built upon.

Stage 3: Leaving a Trace of Reasoning:

All the practitioners agreed on the importance and usefulness of this stage. According to them, this is this stage where the method demonstrates its greatest value. The method appears genuinely helpful in that it formalizes what managers had already intuited and allows more in- depth reasoning.

The method thus appears to be very useful as it provides practitioners with an effective method of operation. In conclusion, the major findings regarding to the use of the prototype are:

- it is pragmatic and therefore easy to use
- it is a communication tool and concept which fosters knowledge distribution and mutual enrichment through dialogue
- it is an organizational tool and concept for the implementation of the BI process particularly with regard to the daily exploitation of information
- it is a training tool which shows how to solve the paradox of perceived information overload and lack of information

Conclusion

Despite the need among practitioners for an appropriate strategic information support method to exploit weak signals, only limited knowledge was available. The exploratory nature of our research thus led us to develop a qualitative methodology which has produced practical and theoretical results that are quite encouraging. First, a complex process has been made more intelligible thanks to a conceptual model integrating both systemic and strategic dimensions. The instrumentation represents an initial exploration into what a suitable set of mechanisms for the creation of collective intelligence might be. Future research could use our model as a framework for the development of information systems aimed at collective knowledge creation. Secondly, articulating knowledge on BI not only improves the ability of practitioners to make decisions within turbulent environments but also helps them to identify hypotheses that are likely to improve the BI process.

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