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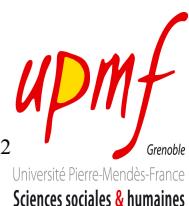
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A Business Intelligence Model for SMEs Based on Tacit Knowledge

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Abstract

This paper proposes a specific model of business intelligence in relation with SMEs practices, culture and competitive environment. This model is based on the mobilization of corporate tacit knowledge and informal information, aiming at interpreting anticipatory environmental information and assist strategic decision making. An empirical survey assessing the existing business intelligence practices in 20 French SMEs has identified seven necessary acceptance conditions of a business intelligence project as well as a managerial tool allowing tacit knowledge traceability.

Keywords: business intelligence, tacit knowledge, SMEs, sense-making

1. Introduction

In highly competitive markets, and because of a complex and accelerated evolution of the economic and technological context, firms need to focus on proactively managing their business intelligence process to ensure survival and to respond efficiently to turbulent environmental changes (Hambrick, 1982; Jain, 1984; Montgomery and Weinberg, 1998; Ebrahimi, 2000; May et al., 2000; Choo, 2002). Business intelligence is the process of gathering and interpreting pertinent information about external environment, the knowledge of which can assist strategic decisions, and generate or sustain long-term competitive advantages (Gilad and Gilad, 1988; Fuld, 1995; Thomas et al., 1993). Many other benefits can be derived from using business intelligence (e.g. see Lönnqvist and Pirttimäki, 2006). Business intelligence requires also a sense-making process and constitutes a privileged means of knowledge creation in the enterprise (huber, 1991; Choo, 1996) in relation with its environment. In this regard, Herschel and Jones (2005) contend the importance of integration of knowledge management and business intelligence in order to improve decision making and firm performance. The study of Heinrichs and Lim (2005) to evaluate the impact of competitive intelligence tool implementation on knowledge creation and strategic use of information shows that knowledge workers can produce greater competitive advantage for the organization when they are assisted by efficient competitive tools.

In fact, knowledge is a strategically important resource (Wernerfelt, 1984; Stewart, 1997; Solow, 1997; Malone, 2002). It can be explicit, easily formulated and transferred to others (Johannesses et al., 2001), or tacit (Polanyi, 1964), that is, difficult to express, formalize, or share (Lubit, 2001) because it is deeply rooted in practice and experience and transmitted by apprenticeship and

training (Fleck, 1996). In an environment characterized by uncertainty and complexity, tacit knowledge helps to create sustainable competitive advantage for companies (Howells, 1996; Nonaka and Takeuchi, 1995). In this setting, it is crucial to integrate disparate global sources of knowledge available within the organizations (Desouza and Awazu, 2006).

In the case of a large company, efforts can be planned to formalize knowledge that is required to interpret and exploit environmental information. In SMEs, such efforts are unrealistic: almost all mobilized knowledge is tacit. The selection and interpretation of environmental information require human competences and knowledge. And yet many SMEs would like to optimize their business intelligence process at lower cost. Because of their specific features, it seems clear that SMEs have distinctive needs in developing knowledge management practices (Sparrow, 2001). In addition, small firm's adaptation and competitiveness depend on its knowledge, detection and interpretation of the trends in its environment (Beal, 2000; Raymond, 2003).

Thus, the main purpose of this paper is to propose an original model aiming at helping SMEs to develop their environmental intelligence by means of business intelligence process, while remaining close to their current practices and culture in order to facilitate the acceptance of the associated organizational changes. It seeks to produce «actionable knowledge» (as formulated by Argyris, 1996), in order to improve the management of useful tacit knowledge for the interpretation and use of business intelligence information.

Our contributions in this paper are three-fold. First, we propose a business intelligence model, supported by a managerial tool and in relation with SMEs practices and culture, through the identification of the necessary acceptance conditions of business intelligence project. Second, despite the fact that researchers have studied intelligence activities based on explicit organizational knowledge, only a few have discussed the role played by tacit knowledge in intelligence management settings. Third, an empirical survey of 20 French SMEs which involved personnel interviews was conducted in order to assess the existing business intelligence practices and to build a model of business intelligence based on the mobilization of the corporate tacit knowledge and informal information.

The rest of the paper is organized as follows. The first part is a presentation of business intelligence activities. The second part focuses on the crucial step in business intelligence related to collective sense-making and highlights the specific role of tacit knowledge during this phase. The third part deals with the research methodology, while the fourth

reports the results and discusses the study's findings and their implications. In the fifth part, a specific business intelligence model is proposed.

2. Business intelligence process

Business intelligence is a collective process through which the enterprise is actively seeking relevant and timely environmental information referred to as "weak signals" (Ansoff, 1975), to grasp business opportunities, increase anticipative capacity, and reduce uncertainty (Blanco et al., 2003). It is also an iterative learning and an adaptive process that helps companies reduce business risk and cope with unstable and unpredictable external events. Lesca (2003) proposed a model referred to as VAS-IC (a French formulation of Anticipative Strategic Environmental Scanning-Collective Intelligence) with a core process of collective sense-making. The main steps of VAS-IC are described in figure 1 below.

The targeting step aims to identify the environmental actors and themes to be monitored and therefore to optimize the costs and time dedicated to the environmental scanning activity. The target definition must be made in a dynamic way according to the operational users' needs. The targeting phase aims also to specify the information needs and sources. Two types of information sources can be distinguished:

- Informal: through contacts with customers, competitors, suppliers, distributors; involvements in scientific symposia and professional lounges; abroad missions and contacts with experts, etc.
- Formal: available in the scientific and technical publications; data bases; enterprises publications; patents and copyright registrations, etc.

Several contributions have shown that personal sources have a richer content, allowing weak signals detection (Ansoff, 1975; Daft and Lengel, 1986) as well as a better comprehension and interpretation of the problems in a situation of highly perceived strategic uncertainty (Daft et al., 1988).

The tracking step refers to the proactive information acquisition about key environmental actors or events and aims to identify environmental trackers or gatekeepers (MacDonald, 1995) which are of two types:

- "Sedentary" trackers who work in their offices with documentary sources and databases.
- "Nomad" trackers who move to reach for external sources. It is the case of the salesperson, for example. The knowledge memorization step manages the traceability and capitalization of the corporate knowledge created during the business intelligence process. This step requires the construction of a knowledge base to set up an intelligent and dynamic storage by creating useful links to structure and organize the collected knowledge. The knowledge base provides an important support to the ongoing business intelligence process when it is assisted by efficient retrieval mechanisms that are able to conduct approximate and heuristic search based on semantic, dependence and hierarchical links.

The diffusion step deals with the dissemination of the collective sense-making findings to the appropriate users. In the same way, a potential user can initiate information requests if he feels the need to have some information he is capable of designating or which has been recommended to him by other users. The phase of diffusion/access also includes the problem of media appropriation related to the nature and features of shared information. The media richness theory (Daft and Lengel, 1986) should be of particular interest in relation to the efficiency of this phase.

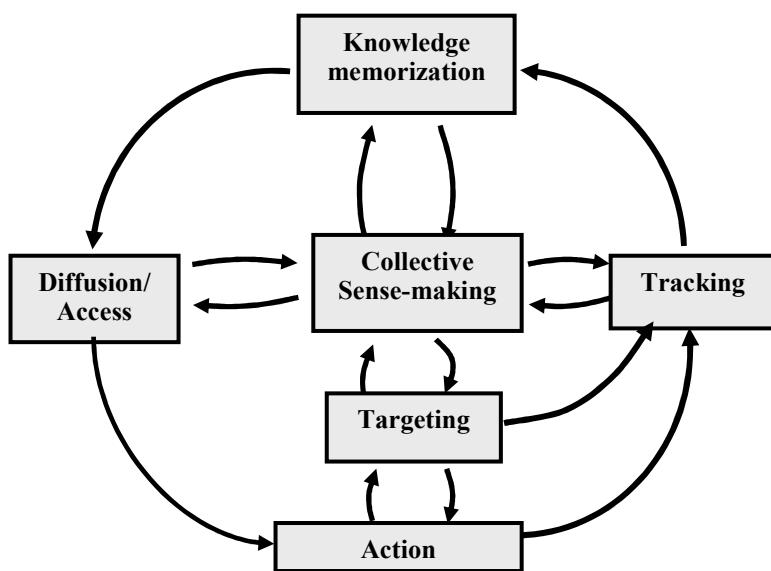


Fig 1. VAS-IC phases

In the action step, if the information that is processed is sufficiently meaningful, it can be integrated into the decision process to provide possible operational fields for subsequent actions. If the output of the interpretation process hasn't reached a clear vision, a complementary request for additional information can be made.

3. Collective sense-making

The core of business intelligence is the collective sense-making. In literature, sense-making has been defined in different ways. It is an interpretative process where people assign meaning to ongoing events (Gioia and Chittipeddi, 1991). It is the amplification of weak signals and the search for contexts within small details fitted together for sense-making (Weick, 1995). It is considered as a creative and collective method that can help the organization to give sense and see possibilities in the surrounding disorder (Choo, 2001; Ashmos and Nathan, 2002).

We propose here that collective sense-making refers to the collective operation during which knowledge is created from some information that plays the role of inductive stimuli, and by means of interactions between individual and collective memories. It describes the capability of a group to create significant links between collected data, which can be inferred iteratively, using the tacit knowledge of those participants involved in the collective work sessions, and supported by data retrieved from structural databases that are updated during such processes. The result of this operation can provide an efficient support to the decision making process by reducing the information ambiguity and the uncertainty of business environment.

Therefore, the complexity and diversity of external events require a dynamic formulation of links and the establishment of variable parameters depending on time or context. The sense-making process should integrate less linear reasoning, especially when sense-making teams are facing unstructured situations, a high degree of equivocality, or incomplete data, which may be encountered by an organization in managing risks, or building development strategies. Thus, this phase gains from using appropriate heuristics in order to reduce complexity reasoning and converge to a collective decision making.

The implementation of the collective sense-making process makes use of efficient tools available in information technologies. This includes a database for storing the data collected and all data traces generated during the reasoning phase, and a knowledge base that stores all the data that has been analyzed, and traces all links inferred through the collective sense-making process.

This definition is illustrated by the conceptual model provided by figure 2. This model must be adapted according to contextual factors of contingency, particularly in the case of SMEs in order to take into consideration the existing practices in such companies.

In addition, efficient collective sense-making rests upon several success conditions. First, it is necessary to detect, monitor and track early signals that could help anticipate strategic threats and opportunities. It, then, requires interpreting these signs to deduce the appropriate hypothetical anticipations. It finally requires knowledge, behaviors, aptitudes, and a high degree of motivation by those who are commissioned to select and interpret signals and data captured from the environment.

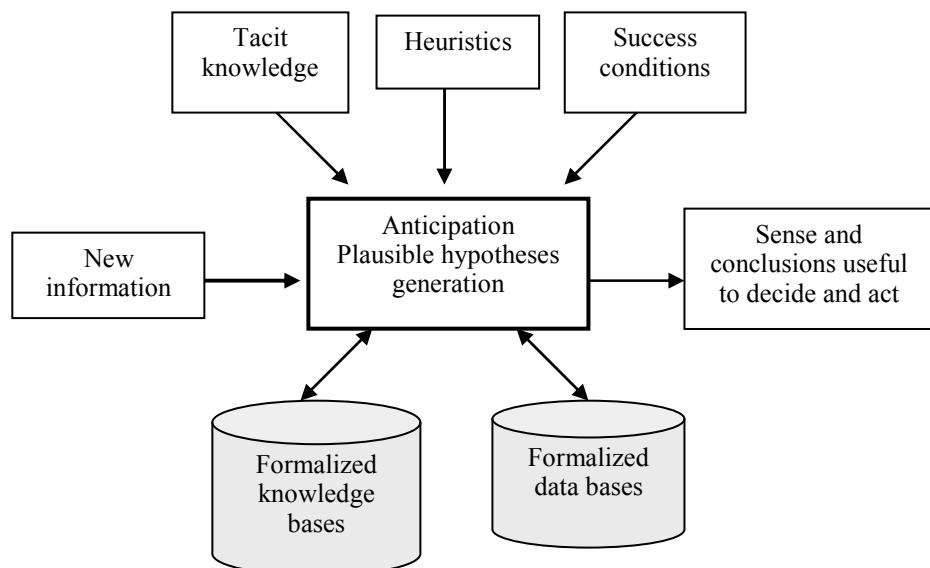


Fig 2. Collective sense-making process

4. Data collection

The data were collected through personal interviews (two hours each) conducted in 20 SMEs with the head of the SME, or his direct deputy. The businesses have between 30 to 300 employees, international activities and subsidiaries, and permanent correspondents in the countries with which they trade. The interviews have been audiotaped and transcribed, then, written up in individual case studies. Then the interviews have been analyzed (Myers and Avison, 2002) by carving out “verbatims”, that were coded in order to be able to locate each verbatim anonymously in the corpus.

We regrouped the verbatim while using the business intelligence model represented in figure 1 as “*a posteriori* reading grid”. We first present the results regarding the possible existence of a formalized system of business intelligence and knowledge management (in relation globally with figure 1), and then the results regarding the phases of the business intelligence process (detailed phases recovered on figure 1 as well as on figure 2). The data collection is exploratory and aims to answer the following questions:

- 1) Is there a global and formalized system of business intelligence?
- 2) Are the possibly collected signs and data stored?
- 3) Are the data sources used, essentially writings, databases, the Internet (formalized / documentary sources)?
- 4) Are the data gathered about the environment formalized at the end of the process?
- 5) Are the circulation and the diffusion of anticipative information systematically organized?
- 6) Do knowledge bases exist to treat the environmental signs and data? or, if they don't, any formalized knowledge? or some occasionally explicit knowledge?
- 7) Does the perceived “time pressure” by SME leader play a specific role to set up a business intelligence system?

We try to discover the possible practices of business intelligence, as they effectively exist in the visited enterprise, even though these practices might be very rudimentary and even if the word “business intelligence” isn't used in the visited enterprise: we are interested in the spontaneous practices (Hamrefors 1998). That is why we ask a small number of questions during the interview and we don't use academic jargon while speaking to our interlocutors. Considering the fact that the visited SMEs are not supposed to have any experience concerning business intelligence, we relied on an open-ended questionnaire.

During the interview we didn't use any sophisticated vocabulary, nor did we even use the words business intelligence or knowledge management. We merely asked if it was important, for this enterprise “to see things coming in its environment”, and if it was important for them “to actively monitor” the possible signs of change. For every answer, we asked for a concrete example, in order to be sure that we understood each other well.

5. Empirical results

Results discussion

Whilst, visited enterprises recognize the usefulness and importance of environmental scanning, most underline the absence of a structured and global business intelligence system due to the scarcity of organizational resources that could be dedicated to this function. However, we could observe in their answers existing practices of business intelligence that are fragmentary, spontaneous and built on the initiative of some isolated individuals.

In most cases, data acquisition and storage are not formalized. Certain enterprise members spontaneously collect field data that remain in an abstract state, memorized only in the mind of the individuals who collected them. Consequently, the collected data are disseminated and not easily accessible if a person needs to mobilize them quickly to make a decision or to triangulate with other sources.

Data are captured in most enterprises with the assistance of informal field sources. Tracker behavior and prior knowledge are involved: the tracker mentally records any information that seems to be interesting or surprising. He makes a selection on the basis of prior knowledge on which he relies and that is activated at that moment. In this way, as soon as it is captured, anticipative information loses its cohesion and becomes removed from its context. It becomes integrated with the tracker knowledge to enrich and to influence his knowledge. According to the assimilation / adaptation process, the recently acquired data and the previous tacit knowledge form the tracker's new set of tacit knowledge. If a tracker shares the new information with a colleague, he might very likely present it not as such, but coated with commentaries derived from prior knowledge. Thus, the colleague in question does not merely receive the so-called information, but a richer perspective (in the sense of Daft and Lengel, 1986). The information flows orally and step by step through enterprise meetings. It can be “push” information, if the information's possessor takes the initiative to talk about it, or more probably “pull” information if someone feels the need to request information.

The individuals' isolation, within a SME, is a counterintuitive finding. Indeed, it goes without saying that in a small company people know one another. But this doesn't mean that information flows easily. It is common to see a good number of collaborators who are constantly on work trips and whom you rarely meet. Organizing a collective work session within a SME is often a daunting task.

In the studied SMEs, we did not find any trace of formalized knowledge at the organisational level. The knowledge mobilized by these enterprises to interpret and exploit information is completely tacit. The interpretation is made in a “spontaneous” way, individually, and without explicit method.

The information tracker spontaneously selects anticipative data that grabs his attention. He doesn't

especially try to rely on any specific selection criterion over another. If we ask him why he selected such data and what use he intends to make of them, he will probably be unable to fully answer. Just as a craftsman, he makes, but is unable to give comprehensive verbal explanation of why and how he makes, which doesn't mean that he does things badly. He is guided by his tacit knowledge, by his know-how, by his acquired experience. He deploys a managerial knowledge (and creativeness in some cases) that is essentially tacit or, in any case, informal, and not engineer's procedural knowledge. The SME leader doesn't see the need for knowledge formalisation which is essentially informal by nature and which constantly evolves with the new experiences. The formalisation task is perceived to be sterile work, paralyzing or expensive. The implementation of a business intelligence system must be considered then as a project of optimization for what already exists, a rapidly-implemented project that produces conclusive results very quickly: a one month horizon already seems to be excessively long and uninteresting. Spontaneously, the SME leader associates the implementation of a business intelligence project to an improvement of his business' agility. If he perceives the project to be long (therefore complicated) then he might deduce that it is bad for his business.

Identifying necessary acceptance conditions of the business intelligence model

We have found out that the empirical study's findings provide seven necessary acceptance conditions (NAC) of business intelligence model, as presented in the table below. We propose using them to help set up an environmental intelligence system within SME.

Table 1: Necessary acceptance conditions of business intelligence model by SMEs leaders

To have more chance of being accepted by the SME leader, the business intelligence system should satisfy the following necessary acceptance conditions:

NAC₁: The proposed environmental intelligence model to the SMEs must be built on the simplest possible formalisation.

NAC₂: The proposed environmental intelligence model to the SMEs must avoid the storage of data.

NAC₃: The proposed environmental intelligence model to the SMEs must essentially build on the use of relational data sources.

NAC₄: The proposed environmental intelligence model to the SMEs must essentially build on the exploitation and interpretation of informal data.

NAC₅: The proposed environmental intelligence model for SMEs must be organized in such a way as to save time and reduce data deterioration.

NAC₆: the proposed environmental intelligence model to the SMEs must avoid the formalisation knowledge implemented to interpret data.

NAC₇: The proposed environmental intelligence model to the SMEs must be immediately 'attractive' for the SME leader. It must provide conclusive results very quickly.

These suggestions could be seen in two different ways either as normative recommendations or as hypotheses.

We have found out that the normative recommendations are not appropriate to the needs of the interviewed leaders. In fact, if the manager of a business intelligence project satisfies these necessary conditions of acceptance, then he should succeed in making the SME leader accept the setting up of an environmental intelligence system. The validation criterion of the hypotheses is therefore the acceptance of the project by the leader. If he is willing to start the business intelligence project, then we can say that the hypotheses are validated, at least in the case under consideration.

6. Toward a business intelligence model based on tacit knowledge and informal information

A major conclusion of our empirical results can be expressed in the form of a paradox. The business owners that we interviewed reject any formalization of business data or the relevant knowledge, yet they wish to optimize current practices in order to be effective and to save time and resources.

We started from this paradox to propose a business intelligence model practically without any formalization, investment, and personnel recruitment. Such a model is based on tacit knowledge management and on the use of informal data.

Figure 3 illustrates the conceptual model derived from figure 2 which is interested mainly in the data and knowledge traceability.

The conceptual model appears to be based on several actors (enterprise employees) and a process of collective interpretation of business information. This process aims to amplify collected informal data, analyze them, and react properly to the inherent threat or opportunity. It is composed of three phases.

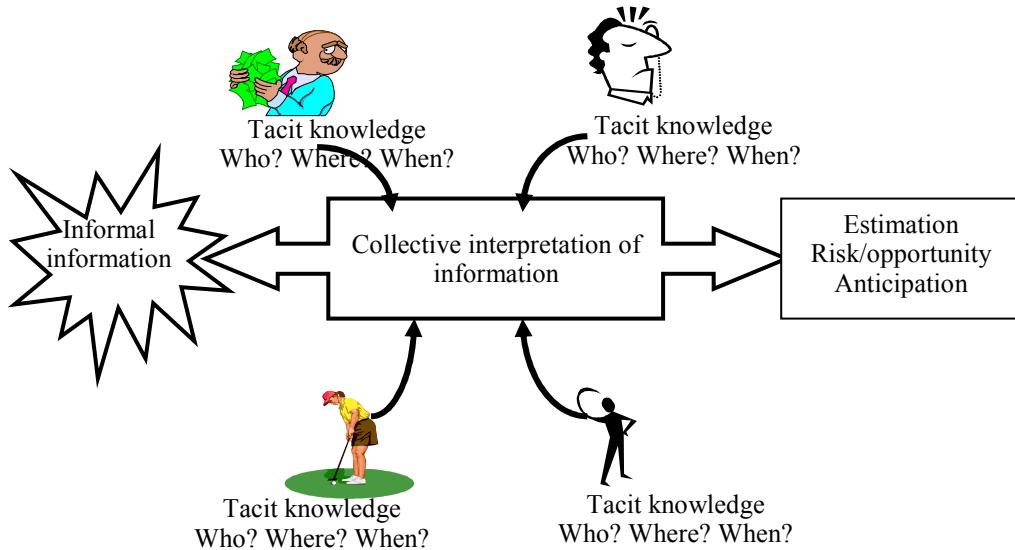


Fig 3. The business intelligence model based on tacit knowledge and informal information

Links initialization is considered as an initial phase. Its objective is to amplify signals and to set up the linkages capable of providing a clear picture of potential risk encountered by the enterprise or business opportunity.

During the second phase, new linkages are inferred iteratively using existing linkages, tacit knowledge of business intelligence actors. The third phase aims to check whether the iterative process has reached a clear knowledge of the risk encountered or the opportunity, and a global assessment of other potentially related decisions. At the end of this phase, a reactive process can be triggered to propose, if needed, the appropriate actions to reduce risk or to take advantage of a business opportunity and to anticipate business decisions.

Thus, we can build a binary matrix M , presented in figure 4 that provides an operational tool and allows identifying, at all times, the trace of useful data or knowledge within or outside the enterprise, provided that it is up-to-date.

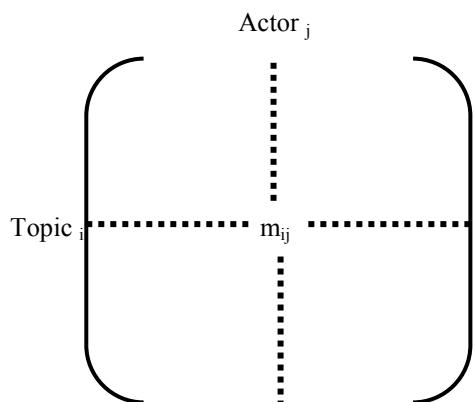


Fig 4. Matrix "Who knows What"

Therefore, let M be the aforementioned matrix and m_{ij} its generic component, m_{ij} is defined as follows:
 $m_{ij} = 1$ if actor j can process topic i , has got the knowledge needed to process or help process the item i .

$$m_{ij} = 0 \text{ elsewhere}$$

In addition, a row in M gives the list of actors who are able to handle a given topic, while a column describes the capability of a given actor to process the list of topics.

Topics include but are not limited to the identification of potentials customers, looking for information about competitors or suppliers, investigation of new markets or products.

The list of topics can be fixed by companies' leaders according to the business needs of the enterprise. This list is neither definitive nor static and can evolve in relation with the targeting activity objects.

The size of this matrix should be kept as small as possible, and sufficiently large to keep the control of all knowledge needed. Indeed, in SMEs of about a hundred people, the number of names to write down in the top horizontal margin hardly exceeds the twenties.

However, the number of lines (where the names of themes or those of outside actors to the enterprise are registered) can reach several dozens (vertical margin on the left of the table).

The construction and the up-to-date maintenance of this management tool, the informal information and the tacit knowledge shouldn't take the person charged to do this work more than half a day per week.

The information that is useful for updating of matrix M has mainly two sources:

- Personnel management service (or other services) supposed to be informed of the travelling of the enterprise members: visits of customers, of colleagues, trade shows, etc. This information permits to inform the table on "who is to contact the

other”, and “who is susceptible to detain some information on what”.

- Contacts (face to face, or by telephone, or messaging, etc.) between the person who cares for the table updating and his colleagues who move outside of the enterprise.

7. Conclusion

This paper has focused on outlining the importance of tacit knowledge for the business intelligence process in SMEs. Our interviews with 20 French SMEs leaders indicate that the acceptance of business intelligence models depends on a number of necessary conditions, including mainly the lack of formalization of storage and interpretation of collected information and the optimization of time and resources allocated to business intelligence activity.

The empirical results also reveal that the exploitation of informal and anticipative data necessary for business intelligence is hardly possible without tacit knowledge mobilisation of many enterprise members. Consequently, the optimisation of business intelligence practices must be based on the tacit knowledge traceability in the enterprise in order to be reactive face to environmental changes. We believe this to be a valuable insight that can make of the tacit knowledge management an operational reality. Due to the exploratory nature of this study, future research on larger samples would help in gaining better perspective on business intelligence practices and address the questions of the knowledge management, particularly tacit knowledge, within SMEs.

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