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# Towards a new approach of support innovation guided by knowledge management: Application on FERTIAL

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**Abstract**

In the context current industrial, the companies consider the knowledge as an important resource and strategic for innovation. For it, a good understanding of intellectual patrimony of the company and its environment promotes the emergence of the new ideas. In this paper, we present a new approach to support innovation which builds on the one hand, on the critical knowledge mapping, respecting the principle of the method MASK, and on the other hand on the exploitation of these capitalized knowledge (mapped) for innovate the production processes using the method TRIZ.

*Keywords:* Knowledge management, Knowledge mapping, Knowledge capitalization, Innovation process, MASK method, TRIZ method


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## 1. Introduction

At the time the information, carried by the new technologies, appears as a major resource for companies, the deficiencies, related to losses of know how (retirements) emphasize knowledge. In our day, the organizations have a growing interest the capitalization and systematic modeling of knowledge and know-how of trades actors linked to the processes and products for the purpose of help them meet their goals for growth and of innovation (Ermine and Boughzala, 2005). Knowledge management (KM) is increasingly recognized within manufacturing firms as a critical approach that can be leveraged to attain competitive advantage and superior performance. Managers realize that knowledge management draws on principles, practices, and technologies from a wide spectrum of disciplines (Hill and Jones, 1998). These disciplines include management information system, computer science, behavioral science, organizational learning, research, and training. During the late 1980's, managers in several industries believed that advances in technology prepared them to manage knowledge effectively. However, they soon discovered that managing knowledge is not a simple issue of managing technology, but it also requires managing social relations and interactions in the firm (Grundstein, 2012).

Knowledge management is a necessity order to ensure the sustainability of organizations and their performance (Tounkara, 2009)**.** According (Gooijer, 2000), defined knowledge management as "those actions which support collaboration and integration". Also (Yahya and Goh, 2002), described knowledge management as "…a process of

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leveraging of knowledge as the means of achieving innovation in process and products/service, effective decision making, and organizational adaptation to the market". For (Grant and Spender, 1996), knowledge management defined as "a socio-technological based system that supports collaboration and integration among interlocking organizational functions to create more innovative and value-added products and services for the market". Knowledge management practitioners and researchers alike support the view that knowledge management requires the integration between the IT systems and people who run the firm as means to attain innovation. Finally, knowledge management systems are guided to capture, create, store, organize and disseminate organizational knowledge (Nonaka and Takeuchi, 1995; 1997).

Several steps were identified in the process of knowledge management: it comes to the explicitation of tacit knowledge identified as crucial for the company, the sharing of knowledge capital rendered explicit in the form of memory, of the appropriation and of exploitation of a portion of this knowledge by the actors of the company (Nonaka and Takeuchi, 1995; 1997) (see *Figure. 1*).

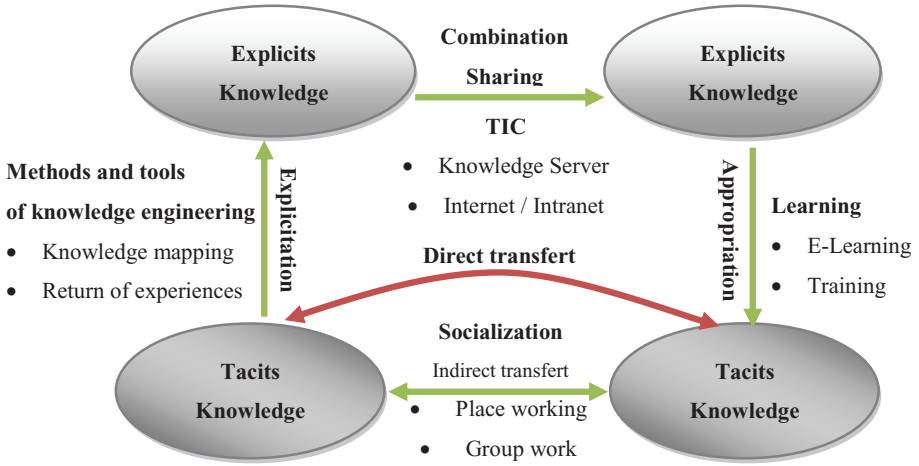



Fig. 1. The process of creation and transfer of knowledge adapted from (Nonaka and Takeuchi, 1995)

In this context, knowledge mapping imposes itself therefore naturally in an organization because the main stake is no longer storing the knowledge and makes it available, it consists rather to do emerge the elements of necessary knowledge, them to be etched into the reference documents, databases or the brains of the trade's actors. In the other words, Knowledge mapping is defined as a set of techniques and tools used to analyze and visualize of the knowledge domain and their relations for the purpose of highlight some specificities trades and the impact of these on the innovation process.

Basis of this observation, we emit the hypothesis that organizations that want to stand out from the concurrency must have a permanent flow of the new ideas leading to new processes or still at new products or services. We raise then the following questions:

1. **Is it really possible to innovate from knowledge (tacit, explicit) capitalized?**
2. **What links uniting innovation and knowledge management?**
3. **What is the impact of the knowledge mapping on the innovation process?**

In a first part, we study the main theoretical concepts that are used in our paper on to the knowledge mapping, innovation, and the using of TRIZ method with its different dimensions. In a second part, we propose a new approach which is based one hand, on knowledge mapping using the method MASK (Ermine et al, 2006; Aubertin, 2006) and on the other hand, on the innovation process by the use of TRIZ method (Alshuller, 2006) for having at end the decision-making .

## 2. Interrelation between knowledge mapping and innovation

### *2.1. Knowledge mapping – Definitions and Background*

In recent years, awareness about the strategic importance of knowledge of an organization that has its strategic value is linked to its knowledge and its exploitation. The potential damage caused by the loss of a key competence and the volume of departures, scheduled or not, most experienced staff alert, in a manner becoming stronger, the need to adopt management strategy knowledge. Indeed, tact/explicit knowledge management is extremely rich and dynamic and it has become necessary to model them. This modeling is used to transform large amounts of data, from interviews with experts to searching documents in multiple repositories that are related to trades activities (Ermine and Boughzala, 2005; Grundstein, 2012). To this end, a multitude of tools and methods exist for knowledge discovery in data, expert interviews, and/or reference materials. These methods are classified into two categories: explicit methods (capitalization) and methods for automatically extracting knowledge (Ermine and Boughzala, 2005; Matta and Castillo, 2009; Nonaka and Takeuchi, 1995).

Knowledge mapping, which is considered as a method of knowledge explicitation, aims to showcase the trade's critical knowledge of the company (Aubertin, 2006). Knowledge mapping is primarily a managerial approach whose finality is to identify the patrimonies of know-how that are strategic in the actions of the trades in the organization. The identification of the latter in an organization is to sustain develop knowledge that is related to the company's business as its work strategy. In the other words, knowledge mapping is a process by which organizations can identify and categorize knowledge assets within their organization – people, processes, content, and technology. It allows an organization to fully leverage the existing expertise resident in the organization, as well as identify barriers and constraints to fulfilling strategic goals and objectives. It is constructing a roadmap to locate the information needed to make the best use of resources, independent of source or form (Ermine and Boughzala, 2005). Knowledge mapping is an important practice consisting of survey, audit, and synthesis. It aims to track the acquisition and loss of information and knowledge. It explores personal and group competencies and proficiencies. It illustrates or "maps" how knowledge flows throughout an organization (Grundstein, 2012). Its main purpose consists in quickly showing the collaborators of an organization, a network or pathway, where is located the expertise sought. Similarly, it allows for the indication of the importance of knowledge that is at risk of being lost and that must be preserved (Matta and Castillo, 2009).

Several approaches to the evolution of mapping have been proposed for organizing the cognitive resources of a company. Aubertin (2006) proposed three different approaches for the realization of mapping by functional classification, which respectively use the organization chart, classification by process, and classification by domains. Matta and Ermine (2001) conducted a project for mapping the knowledge and the technical competence that are critical within the direction of the innovation and research of the INRS. Ermine and boughzala (2005) completed a project at Chronopost International (observatory of trades), which relies on the following two objectives: first, to identify the know-how of trades that are affected by the strategy; and second, to consider the evolution of critical skills in the future. For this, Ermine J.L. built upon the project in several phases: the first phase is the realization a mapping that is strategic in regards to business actions and that is formalized by the graphical model approach of "a map of knowledge domains." The second phase consists of an analysis of the know-how of the trades that are critical. This is done through the use of criticality criteria and takes into account the specifics of Chronopost International. Chabot (2006) proposed a complete mapping of the different areas of expertise to the company HYDRO-Quebec. However, the primary objective was to on one hand, identify the areas of knowledge, and on the other hand, to do a study of criticality in order to bring out the critical knowledge domains with the help of the French Society Kadrant. Barroso and Ricciardi (2003) conducted a project at the center of radio pharmacy in Sao Paulo (IPEN). Since the nuclear domain suffers from problems related to this considerable accumulation of the knowledge, such as the risk of non-preservation, the difficulty of transfer, etc. they have developed the project in several steps by using a process approach. The process was described in a conventional manner in the form of flow diagrams linking the activities that in the process. Knowledge Engineering (Charlet, 2003; Aussenac-Gilles et al, 1996) offers a rational framework allowing a representation of knowledge obtained through the experiments (Matta and Zaher, 2008). This technique found a great application in knowledge management and especially to capitalize knowledge (Deing and Matta, 2002). For that, we find in these approaches in one hand, models representing tasks, manipulated concepts and problem solving strategies, and in the other hand, methods to extract and model knowledge. We note for instance MASK (Ermine et al, 2006; Matta and Ermine, 2001) and REX (Malvache and Prieur, 1993) methods. These methods are used mainly to extract expertise knowledge and allow defining corporate memories.

## 2.2. Innovation – Definitions and Background

### 2.2.1. Definitions

Innovation is crucial to the success and survival of companies. It is seen as the single most important building block of competitive advantage. "Successful innovation of products or processes (or services) gives a company something unique that its competitors lack" (Hipple, 2005). Different types of innovation can be delivered, for example it may be a product-, process- or organizational innovation. The scope of innovation can range in scope from radical/disruptive to incremental/evolutionary innovation) (Christensen, 1997; Trott, 1998). Depending on the type, complexity and scope, the role of knowledge in the innovation process is crucial. For more radical innovations, new knowledge needs to be created or applied from very different contexts. For incremental innovations, it is more important to re-use existing knowledge in many aspects of the product's design, manufacture and delivery (Le lann, 2007).

Various mechanisms exist to deliberately feed new knowledge into the organization, for example communities of practice, the reading of technical journals, conversations with customers and suppliers etc. Literature supports the view that you need new, external knowledge to generate innovation (Miller and Morris, 1999). Tasmin and Woods (2007), commenting at an organizational level, suggested that borrowing rather than invention was fueling innovation. Additionally information useful to innovation can come from other internal units in the organization. So in different organizations particular sets of practices for feeding and creating knowledge and sources from which it is drawn may be found.

### 2.2.2. Innovation and using of TRIZ method

Today innovation is more than a need, it is a company policy. In the literature, we find several methods to generate innovation in the projects of company (the creativity tools, the theory C-K (Creativity – Knowledge) of Hatchuel and Weil (2007), and the TRIZ method of Altshuller (1999; 2006)…). In the context of our works, we are interested specifically here; to the TRIZ method (Theory of Invention Problem Solving) that is a set of methods, processes and tools for conduct innovation.

The analysis of the literature highlights that TRIZ is for sure one of the most known systematic approaches for creative design. According to Zhang et al (2010), TRIZ methods are based upon prevailing trends of system evolution (predominantly, technological systems). These trends were identified by examining statistically significant information from different areas of intellectual activities (mainly, technological innovation). In paper of Yamashina et al (2002) TRIZ method is presented as a method that "opens up the pragmatic orientation of engineering creativity, represented more modest by value analysis (engineering) and by numerous analitico-matricial methods (e.g. arrays of discovery). According to Apte (2009), TRIZ was developed successfully as a powerful problem solving tool, especially for product innovation design in conceptual design phase, to promise the engineers with breakthrough thinking.

The goal of TRIZ, as it is known today, is to support inventors when they have to solve primarily technical or technical-economical problems. The fundamental idea of TRIZ is to provide them with easy access to a wide range of experiences and knowledge of former inventors, and thus use previous solutions for solving new inventive problems (see figure 2).

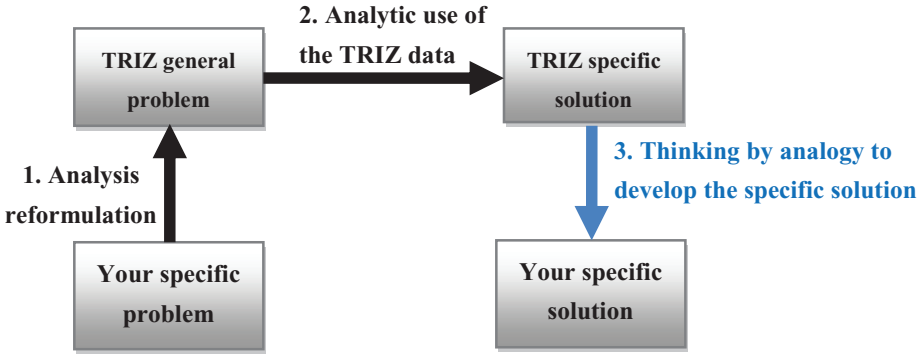



Fig. 2. Problem solving with TRIZ tools at different levels of abstraction (Leung and Yu, 2007)

Problem solving within TRIZ can be described using a four-element model (Fey and Rivin, 1997):

1. The problem-solver should analyze this specific problem in detail. This is similar to many other creative problem-solving approaches.
2. He should match his specific problem to an abstract problem.
3. On an abstract level, the problem-solver should search for an abstract solution.
4. If the problem-solver has found an abstract solution, he should transform this solution into a specific solution for his specific problem.

During this process, TRIZ can support the problem-solver by accumulating innovative experiences and providing access to effective solutions independent of application area (Dubios et al, 2008). Consequently, TRIZ has the capacity to considerably restraint the search space for innovative solutions and to guide thinking towards solutions or strategies, that have demonstrated its efficiency in the past in a similar problem and, in this process, to produce an environment where generate a potential solution is almost systematic (Hipple, 2005).

## 3. Research approach

### *3.1. Context research*

Manager the knowledge and the skills of companies is one of the challenges ahead, the knowledge constitute an essential factor of the development, of performance, of profitability and of innovation. For evolve, any person needs to discern its know-how, to evaluate its skills in order to them reinforce. Experience feedback is then made at the individual level, at the team level and at the company level.

To realize our new approach, we have opted for the Algerian company of Fertilizer (FERTIAL). The latter conducts a research project in collaboration with the research team to be able bring elements of response to support the innovation process.

National Fleuron of the petrochemical industry, FERTIAL (Fertial, 2014), Company of Fertilizer of Algeria, is a company resulting from a partnership signed in August 2005 between the Group Algerian ASMIDAL (Asmidal, 2014) and the group Spanish Grupo Villar Mir (Grupo Villar Mir, 2014). Also, it is composed of five major divisions specialized in numerous activities related especially the manufacture of fertilizers and agricultural fertilizers. Indeed, the security is a key factor in the Industrial Policy and Human Resources, as well as staff training, quality and respect for the environment. The goal most important for the company FARTAIL is to achieve zero accidents and ensure industrial safety of the surrounding communities by proposal an approach of knowledge capitalization in the trades' and its exploitation in the projects. These projects were intended for among others to the renovation and modernization of industrial facilities to improve their capacity, the acquisition of new digital control system, to the environment and to the security.

Finally, the FERTIAL Company enrolled fully in a market of the fertilizer strongly competitive, striving reduces its costs, its development cycles and in a continuous improvement approach of the quality and its innovation process. Develop an innovation process closely linked to knowledge trades of the group is therefore a priceless asset.

### *3.2. Experimental protocol*

The literature of technology shows us that the success of a generation of innovation depends on the context in which to situate the patrimony of knowledge. In order to address the need for generation of innovations from the capitalized knowledge (tacit and explicit), we decomposed our approach in two parts (see figure 3):

1. The knowledge capitalization via critical knowledge mapping using the principle of the MASK method in order to highlight pathways of innovation,
2. The generation of innovation with as a resource the capitalized knowledge (critical knowledge mapping).

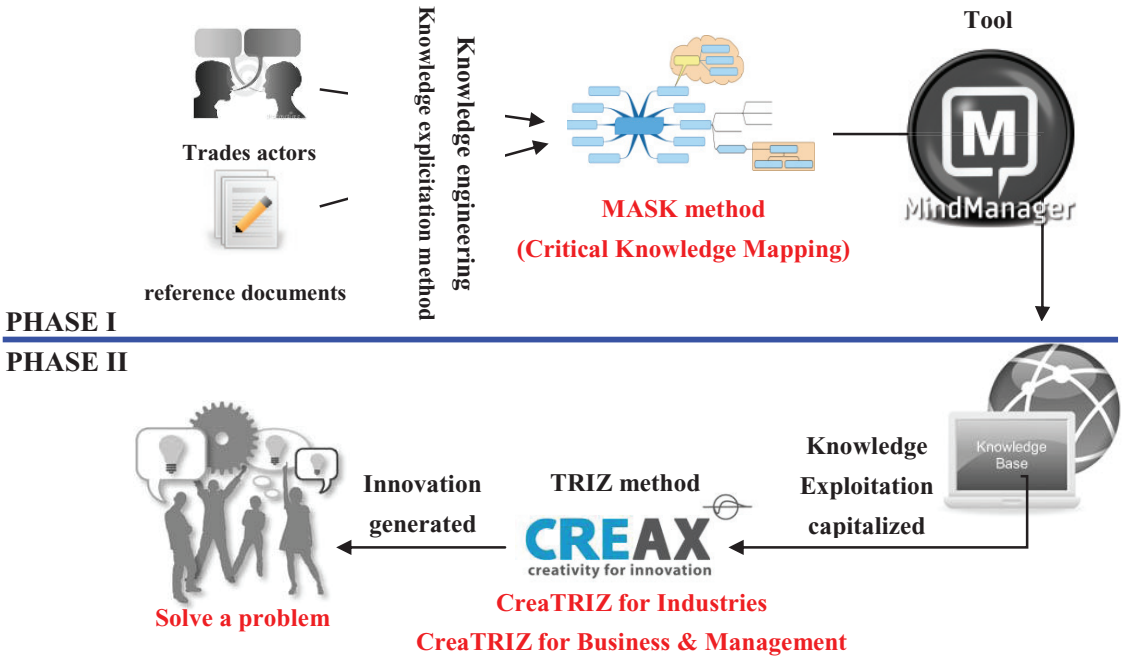



Fig. 3. The problematic industrial of support innovation guided by the knowledge management

The model of "generation of innovation starting from knowledge capitalized" is formalized with the aid of software tools, that we consider a full-fledged product (inseparable nature of the two computer software: tool of knowledge capitalization and generation tool of innovations).

As we have seen previously, the direct passage of knowledge (tacit and explicit) to innovation is not possible. However, the model that we proposed is based on the hypothesis that is possible to generate innovation starting from knowledge capitalized passing through the knowledge base is to verify.

In the life cycle of the knowledge base, the first phase of our approach feeds the knowledge base through the MindManager tool (MindManager, 2014) (tool of analysis and knowledge visualization) by critical knowledge mapping strategic / trades. The second phase exploits the knowledge base through the TRIZ method.

### *3.3. Experimentation*

#### *3.3.1. Realization of the critical knowledge mapping*

Experience has demonstrated that the implementation of an effective knowledge management goes through the establishment of knowledge mapping. Thus, the knowledge mapping is a means of navigation (cognitive) to access the resources of a patrimony of knowledge in an organization, and to be implied or explicit. More so, the knowledge mapping allows having a fine understanding, by a criticality analysis, the domains of knowledge on where efforts should be made in terms of capitalization, sharing, or innovation (Aubertin, 2006). Moreover, the field of knowledge mapping presents itself as an emerging research domains where there has been little work done that can be identified in literature and the work that has been done is not thorough (Ermine et al, 2006).

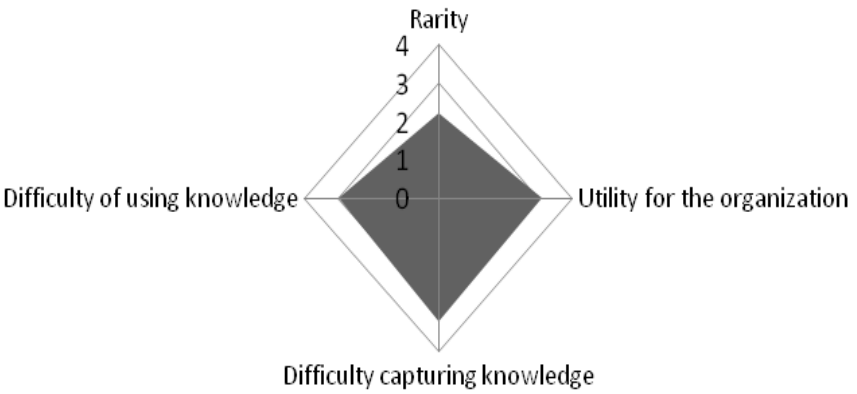
There are various approaches to organizing the cognitive resources of an enterprise or agency. However, we can distinguish two types of cartographic approaches. The first focuses on classification by process and on the classification by domains that organize the knowledge around the subjects, objects, or purposes of common interest that have been identified in the organization. The method of critical mapping knowledge, MASK, is classified in the latest approach. The latter (MASK) proposes in parallel to formalize the strategy and to identify strategic competencies and other items by achieving a criticality analysis of knowledge domains with the trades. The evaluation of the latter is elaborated on the basis of a library of the criteria or a grid CFK (Critical Knowledge Factor) that has

been elaborated on by the Knowledge Management Club and tested in various contexts (Aubertin, 2006; Ermine et al, 2006; Tounkara, 2009). The strategic alignment allows crossing the two points of view and for identifying strategic actions to improve the performance of the organization. To begin the generation of innovation, the map was created to visually represent the domains critical knowledge (or different know-how critical trades) of the FERTIAL in a synthetic and intelligible way. We recall, in this step, that the realization of the map was based on an analysis of references documents (organizational chart, description of the distributions of activity services, directory of staff activities, plan medium term of the production, studies, etc.) and interviews with of about fifty persons involved in the different processes (actors of the knowledge or trades experts) and others who are responsible in FERTIAL.

The adopted principle of knowledge mapping is to group the different activities' knowledge domains, of them get in shape format via a representation vulnerable then the complete and validate the mapping produced with experts, in an iterative manner. These iterative validations allow having co-construction work. They also guarantee the maximum involvement and appropriation of the interviewees. The result is a map of knowledge domains or know-how map trades. This mapping is a description of a level of the meta-knowledge (Grundstein, 2012) of FERTIAL know-how. It provides a system for being able to address know-how in order to facilitate access to knowledge domains.

From this map, a study, thought, criticality was realized, which took into account the specificities of FERTIAL service and expected project mapping. The criteria presented in the map are organized into 4 families (Difficulty to capture knowledge, Difficulty of usage of the knowledge, Rarity of the knowledge, and Utility of the knowledge) Ermine et al, 2006). Each criterion is designed to be valued. For this to happen, we have established an evaluation scale for each criterion, based on the evaluation method that was developed by the Knowledge Management Club or on the Critical Knowledge Factors (CKF) (Aubertin, 2006; Ermine et al, 2006; Tounkara, 2009). We recall that critical knowledge is knowledge that has value but is difficult to exploit. In our case it is for each knowledge domain (from interviews), to assess the risks and opportunities related to the availability, nature, utility for the FERTIAL, and accessibility of know-how it covers.

From (Aubertin, 2006; Ermine et al, 2006; Tounkara, 2009), the criticality of a knowledge domain is to assign a score from 0 to 4 in order to represent the degree of realization of the criterion of grid analysis for each domain. The purpose of criticality analysis, which is viewed through the grid of criticality criteria, is to objectively determine which knowledge domains are the most critical for the future of the company and to recommend actions to prevent risks in these domains. More the domain is critical within the meaning the criterion evaluated, higher the note is high. Each evaluation of criterion rests on a synthesized question. When the respondent does not know the answer, a score of "0" is assigned. This note will not be taken into account during the analysis. A complementary analysis was conducted on the basis of combinations from the criterion and/or groups of criteria that were chosen in relation to the objectives of the criticality of the study. An interesting aspect of this analysis is that it allows bringing out some specifics (i.e., the niches of expert current/future domains to enhance the highly sensitive domains, etc.). A tool (i.e., Excel) was used for the restitution of these results in graphical form, especially for the radar chart (Kiviat diagram) format. The radar charts compare the values of criticalities of knowledge domains that have been aggregated into multiple data series that have been collected from different interviewees (see figure 4a and 4b).



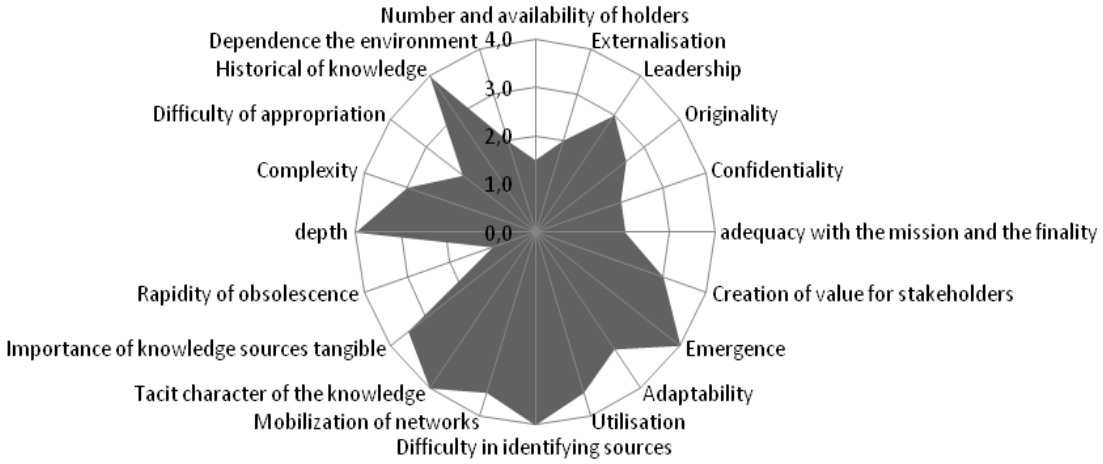



Fig. 4. Diagrams for the automatic analysis by Excel tool "(a) thematic axes; (b) criteria of criticality"

The result is a map of domains of critical knowledge or a map of know-how/strategically critical trades (see figure 5). This mapping is a description of the level of the meta- knowledge (Grundstein, 2012) of know-how FERTIAL. This mapping provides a system for the addressing of the know-how critical in order to facilitate sharing.

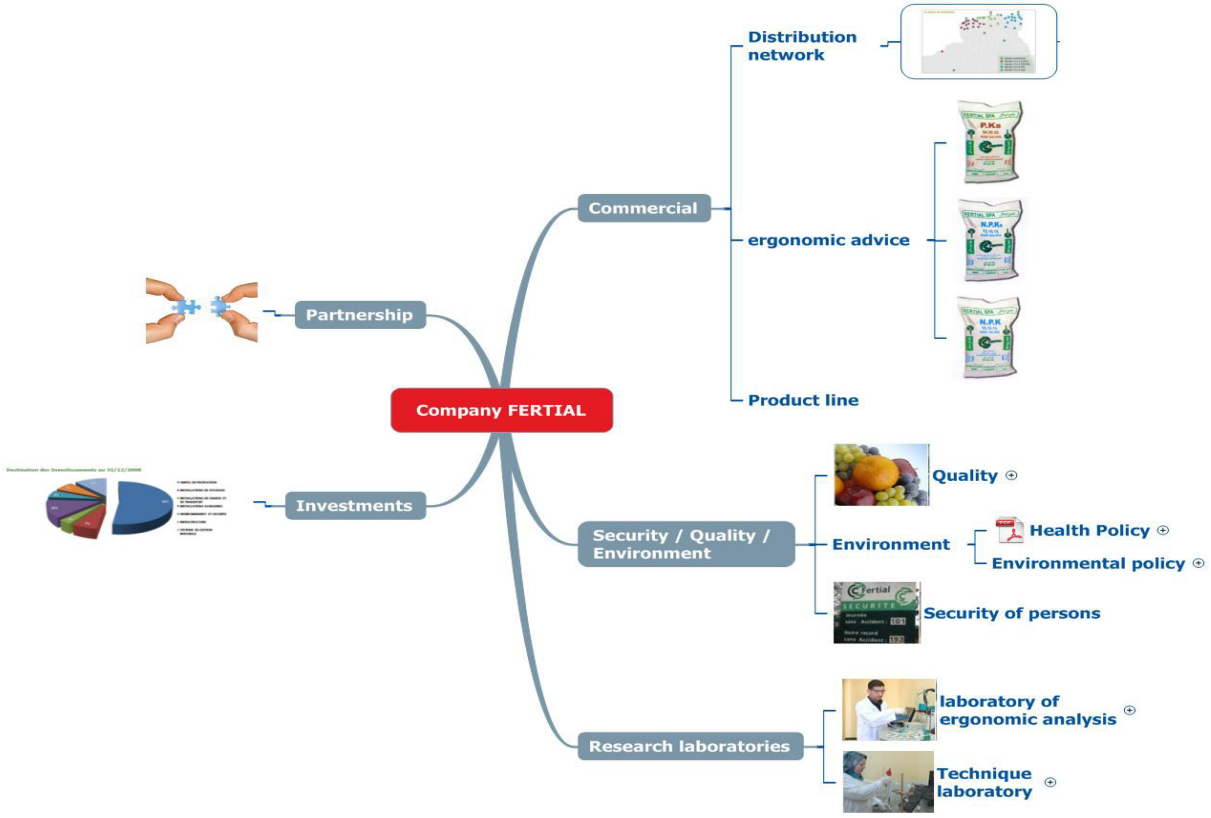



Fig. 5. Critical knowledge mapping of FERTIAL Company by MindManager tool

*3.3.2. Innovation process by TRIZ method*

We decided to use the TRIZ method concerning the application of innovation support for multiple reasons. First of all because the constraints of industrial realities impose to solve the problems of innovation increasingly quickly; henceforth a company cannot afford to adopt a technique of trial and error to satisfy this need (Moehrle, 2005). It is important to stress this remark because this is one of the main reasons for the existence of TRIZ method. Also, the TRIZ method makes it possible to conjugate the tools and the methods fostering the analytical and rational approach the capabilities of the individual, a view to increasing the potential for innovation (Meylan, 2007; Phaal et al, 2010).

In this context and for exploit the knowledge capitalized previously via the TRIZ method, we have chosen to use the software CreaTRIZ (the CreaTRIZ software for Industries, the CreaTRIZ software for Business & Management) of the CREAX society (Creax, 2014).

CREAX now offers you the latest high tech software support that helps you with your innovation process. You get benefit driven access to systematic innovation, tools to systematize your creativity and to help you manage the complexity of your problems. You can analyze your current products in no time and solve your problems using the strategies of the best inventors worldwide. In addition, CREAX consists of two independent modules basic: the CreaTRIZ software for Industries, the CreaTRIZ software for Business & Management and the Evolutionary Potential program.

## 4. Conclusion

The fertilizer industry generates a high level of knowledge whose management is critical for survival in environment concurrencies. Make quickly a decision and understand the effects of actions taken, these are the challenges which must to face the production units. For it, the principal objective of our paper is to demonstrate the possibility of generating paths of innovation and / or innovative products from the trades knowledge capitalized. In addition, we have thus demonstrated that it is possible to generate innovation in rupture by the TRIZ method taking as input data for the detection of problems the implicit knowledge of the trades actors formalized according the formalism of the MASK method. Finally, the next step for the company FERTIAL should reside in the integration of this new method of design / innovation in the innovation process. To this effect, it will then answer the question: How to transpose this model in operational FERTIAL?

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MindManager, Official Web Site: www.mindjet.com/?lang=fr , MindManager is software for creating mind maps. It is developed by Mindjet Corporation. Mindjet specializes in Business Mapping.

The company CREAX, official Web Site: http://www.creax.com/ , Creativity for Innovation.