To initiate a corporate memory with a knowledge compendium: ten years of learning from experience with the Ardans method

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Abstract. Ardans method ArdansSas (2006b) and technology ArdansSas (2006a) of knowledge capitalization and structuration are used with different industries (automotive, aerospace, energy, defence, steel, health, etc.) for more than a decade in France and Europe.

The proposed solutions in knowledge management and especially in expertise capitalisation have set a lot of feedback over time. With a view toward ongoing improvement, what are the impacts of these feedbacks on the method nowadays? Put into practice into the industry, the return of investment of a capitalization campaign is inferred from the quality of the knowledge base delivered at the end of the campaign. Therefore, the method and the technology are intrinsically connected. How IT tools can assist with the quality diagnosis of the knowledge base?

A comparative study was conducted on the basis of the method Mariot et al. (2007) exposed at EGC'2007. This article sets out the results of the changes and improvements of the method, in conjunction with the latest technical and scientific development on the one hand, and the change of the industry needs on the other hand.

1 Introduction

Knowledge management inside industry has sometimes constraints that does not depend on how much data you have to process or how "clean" is the raw data. The method described in ArdansSas (2006b), MAKE, focuses on problems that have three main constraints. The first one is obviously the financial pressure where the knowledge management projects take place. The second one is the time pressure: knowledge management project are designed to be closed in some days or weeks. In these time windows, the problems must be identified, a solution must be designed, built and deployed. From then the work is finished for the knowledge consultant, and the firm must lead the second phase (to give access to the knowledge to the learners) on its

own. The last constraint is the most important one, conceptually speaking: what can we do if the data is not written?

These three constraints have given a lot of pressure to the method since 2006. This article will focus on what has been changed so far. It will describe the applicable perimeter in section 2. Sections 3, 4 and 5 will focus on what changed on the base materials definition and selection, the process, and the products respectively.

The feedback is based on many industrial cases, three of them were already described in some papers: the ICARE project (Berger and Mariot (2007)) together with PSA Peugeot Citroën, the MDOW project (Verhagen (2010)) conducted together with EADS, and the ALPIN project (Louis (2012)) conducted together with Air Liquide.

2 Perimeter

For a better comprehension of what is discribed in this article, it is important to consider different knowledge management levels in the industry. This method should be applied when the data is not present on the Internet, nor in any file system, but inside human brains. As a consequence, this data is not accessible. But interactions between people give directly what is needed: not data but knowledge. Interactions between people are the "management" part in "Knowledge management". The goal is to identify the knowledge, to structure it, to validate it, to share it and to make it fructify in a dynamic way. This knowledge management is human centred, and begins from ideas to data (top-down approach) much more than data to knowledge (bottom-up). The knowledge will be given or explained by little groups of "knowers" (for instance a Research and Development team of five people) in a given field, and not by hundreds of employees in all the fields involved in a given organization. This is much a psychological approach than sociological one. This particular view of knowledge management can be called expertise management. Automatic knowledge gathering or inference making from information (for instance from html pages) is very different from "manually" creating a link that makes sense between concepts, with the help of experts, and in order to transfer the knowledge in a purpose. The keywords of MAKE are "expertize", "by hand", and "on purpose".

One of the models often used to categorize the content of human mind is the following: the data is the minimal symbolic entity; when the data is processed to be useful (when it answers the who, what, when, when questions) it becomes an information; when data and information answer the how question, it become knowledge; when it appreciates the why question, it becomes understanding; when this understanding is evaluated, it becomes wisdom. This model has two drawbacks for knowledge management applied in the industry: the first one is the word "data" that can refer to data in mind and computer stored data, which is confusing. The second one takes place in situation: when people talks and learns from each other (let us say that there is at least one of them understanding things, so creating knowledge), it is not really useful to discriminate data, information, and knowledge to understand better what you are learning. Rather the opposite, understanding is made when data, information and knowledge are melt in a soup when proportions are well set. Data without meaning is useless and the meaning comes in a context. The underlying model of this method is more borrowed from cognitive psychology: communication and understanding are made by sharing and creating representations. The useful representations to identify, structure, validate, share and fructify are told "knowledge", and they only take place in mind. In this paper, the term knowledge refers to a collection of

representations that have a sense and a value in a given field of interest. The recording of this knowledge on a paper or in a computer memory makes new "data", not more. The interesting part is when the computer can display all the collected representations in a form that gives other representations. Emergence of knowledge from the gathered knowledge can occur when people see the results. For example when data visualization can be interpreted as a map of knowledge, it is possible to evaluate quickly how much knowledge must be learned in a field of interest towards another. There is meta-knowledge as there is meta-data. An example of this meta-knowledge is described section 5.

The aim of MAKE method is to give a solution that improves knowledge gathering from small groups of knowers, knowledge dissemination to bigger groups of learners and knowledge growth. The MAKE method is entirely described in ArdansSas (2006b), and Berger and Cotton (2011b), this article will not focus ont it but on its the changes and evolutions.

When comes the time to share, it is nowadays difficult to design a solution not computer oriented. But whatever may be the solution, a design process to create or configuring a tool according to a certain field inside an ecosystem of a given firm leads us to knowledge engineering.

In this method, expertise management and knowledge engineering are closely related.

3 Base materials

Since 2006, two main goals have been identified when the need of an expertise management study is expressed: storing knowledge and sharing knowledge.

Storing knowledge is the act of identifying, structuring, validating and recording knowledge out of brain. Robust media must be studied to resist "data erosion" (for example the fact that some file formats become too old to be read by current software). In fact storing knowledge is recording representations into data in the way that people in the future could create representations as close as the initial ones by reading this data. The challenge is to get the closest representations as fast as possible. When storing knowledge, data will stay as it during years.

Sharing knowledge is the act of identifying, structuring, validating knowledge, to initiate a critical mass of curated content that will generate interest and attract people in the field. The second step is to design a solution to share the knowledge, to train people to use the solution, and to make the group of knowers and the group of learners fructify knowledge by making them interact.

3.1 When storing knowledge

Storing knowledge seems to appear when a lot of knowledge have been accumulated in a certain field but will not be longer useful at short or mid-term. But not useful at short-term does not mean without value at long-term. The knowledge can be stated as strategic in 10, 15 years or more. Sustainable data storage hardware and format are indeed very important. But based on the stored data, will the next generation of learners be able to make good representations? Vocabulary can change, references to disappeared technologies can occur, etc. A way to prevent misunderstanding as much as possible is to put consistency as much as possible. This is discussed in section 4. The idea is that a concept is less difficult to understand if there

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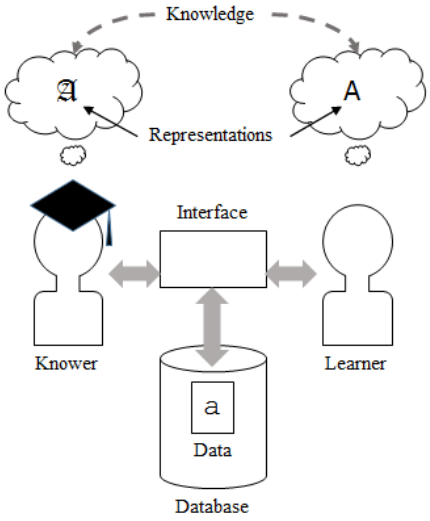

FIG. 1 – *A simple schema of what is knowledge, representations and data in MAKE.*

are relations explained with other concepts: an unknown word can sometimes be understood inside a sentence.

Another scenario has been observed: a firm has a big know-how in a very precise technology due to research and development efforts given to it in the past 10 years, but doesn't know if the market is ready yet. A strategy can consist in taking the risk of designing a new product based on this technology, but another one is to wait for competitor's move. If the firm have reliable indicators on its competitor's activities, it can chose to launch the design as soon as the competitor does it, saving a lot of money in marketing studies without taking any risk. But this is only possible if the firm can recall very quickly the stored knowledge. In that case, recovering time is the key of success. Knowledge structuration and a good tool to access it quickly seems to be the main solutions. They are respectively discussed sections 4 and 5.

For the storing plan, two base materials are needed: the group of knowers and a knowledge manager. The group of knowers is a small group of people that is called "key people" in a certain field. It has been observed that these people are called "experts" and have sometimes more than 30 years of experience in the field. They are usually in the higher tier of the hierarchy in the company but it is due to their experience, not only their graduations. Their experience has obviously been gained on a long work in Production or R&D.

The knowledge manager is the second component to start a knowledge management project. The knowledge manager task is to give a boost to the dialog with the knowers' group and help them verbose their knowledge. The knowledge manager will have to design a planning with the knowers to set meeting sessions of interviews. Some of these interviews will take place with all the knowers' group and others will take place only face-to-face when very specific topics are talked about. The future users' group is not known at the moment to help designing the technical solution. For storing plans, the solution is usually a book or a static website.

These solutions are exposed in section 5.

Usually the leader of this kind of project is seldom called "Knowledge Manager" if he comes from inside the firm.

3.2 When sharing knowledge

The need of sharing knowledge comes when companies want some living memory, contrary to the storage plan. The aspects of saving and transmitting are real time. The knowledge is qualified as “critic right now” and for the future. Furthermore the company is in the mood of gathering and sharing knowledge along the way. This means that the learners’ group and the technical solution are much more important than in the storage plan. The technical solution is exposed section 5.

The learner’s group is the people that will have to study the data in order to get the knowledge. For the sharing plan, it is very important to know them and get them participate to the elaboration of the solution. They will not be part of the discussion between the experts and the knowledge manager but they are willing to explain their needs to design the better interface between the collected data and the final users. They will explain what they need to learn as fast as possible.

The knowers’ group is restraint and have a lot of experience. The learner’s group is usually bigger, younger and have a lot of energy for creation. Smooth team work and communication between these two groups will not only enhance knowledge sharing but knowledge production and innovation.

3.3 Conclusion

Since 2006 two concepts where consolidated: the availability of the knower’s group, and the skills of the knowledge manager.

The owners’ group time availability is one of the key of success. Usually, the knowers will have to participate to the sessions in the knowledge management project along with their usual daily job. If knowers can’t free enough time for the project, the project can’t be conducted.

In all the companies prospected in ten years for knowledge management projects, only a negligible proportion of them already have or are willing to have their own knowledge managers or knowledge engineers, at least in France. Usually the Knowledge Manager is the Quality Manager, the Method Manager, or the Continuous Improvement Manager. Inside this thin proportion, only one of them (Commisariat à l’Energie Atomique et aux énergies alternatives) have different knowledge managers that have precise skills according to the knowers’ group they will have to manage. They are researchers that have a part-time job of knowledge manager. The most of the prospected companies do not have any knowledge manager. Their strategy is to loan services of consultants when the need identified. That means that it is very rare that the company in question will get a knowledge manager with skills in the field to be shared or stored.

Furthermore, every project in knowledge management the past ten years concerned sharing or storing very precise knowledge, but not general knowledge in a large field. It is obviously better to have a knowledge manager that is an expert in the topic, but it is not possible to have as many knowledge managers as many fields the companies will have to create a project into.

These observations have confirmed that the knowledge managers should have a high degree in science or technology to understand the knowers, but they must have human oriented skills in organization and management; “human skills” are mandatory to create a good group dynamics and a sense of commitment. Knowledge management projects in non-technical or scientific fields are very rare compared to the former ones. Last but not least, half of the knowledge management projects were tagged “confidential” by the industrials in the past ten years.

The success of a knowledge management project between two industrials begins with these three keywords: understanding, confidence, and mobilisation.

4 Process

In section two has been defined the notion of expertize management, which is more precise that knowledge management in the paradigm of the Ardans method. By the way, “knowledge management” can be used as “expertise management” in this article.

Knowledge capitalization is the backbone of an expertize management project. Knowledge capitalization is the activity of understanding, appropriation and reformulation of the knowledge given by the knower to the knowledge manager.

Ardans SAS provides three KM consultants only dedicated to lead expertize capitalization projects. These projects involve from one to ten experts or knowers and focus on a specific scientific or technical field of interest. Ardans also designed an information technology tool used by its consultants to model and store what they learned from the experts. This same tool can be used to maintain the stored information at an updated level during years through a web interface. This tool has been designed more than ten years ago and still under modification. A team of programmers is aware of the consultan’s needs and feedback.

A one to one project (on consultant and one expert) is usually designed to be closed in three or four months. The experts explains the knowledge to be capitalize during half days sessions.

The question of sharing knowledge or storing knowledge can be viewed as producing expertise or keeping expertize. Expertize is produced when more and more learners become knowers, or when collected data grows with the hypothesis of that dis data is read and understood (it means that learners continue to learn). Expertize is kept when at least all recorded data can be reproduced by at least one knower. Saving data is not keeping knowledge. Saved data should be got “out of the fridge” once a time to be sure that there is at least one brain that keeps the knowledge. It can be concluded that if knowledge is shared continuously, it is saved. The technical solutions used to share knowledge are as important as the tools used to store and display the data. Ardans does not provide expert systems.

4.1 Knowledge identification

The very first meeting between the knowledge manager and the team of knowers is to define the limit of the study by enumerating topics. The topics will generate knowledge elements, links between these elements, keywords, hierarchy of keywords and links between knowledge elements and keywords. The visualization of these identified elements in clusters can help a lot the organization of the project. Some clusters can be affected to some people and their study can be ordered in time to optimize time management.

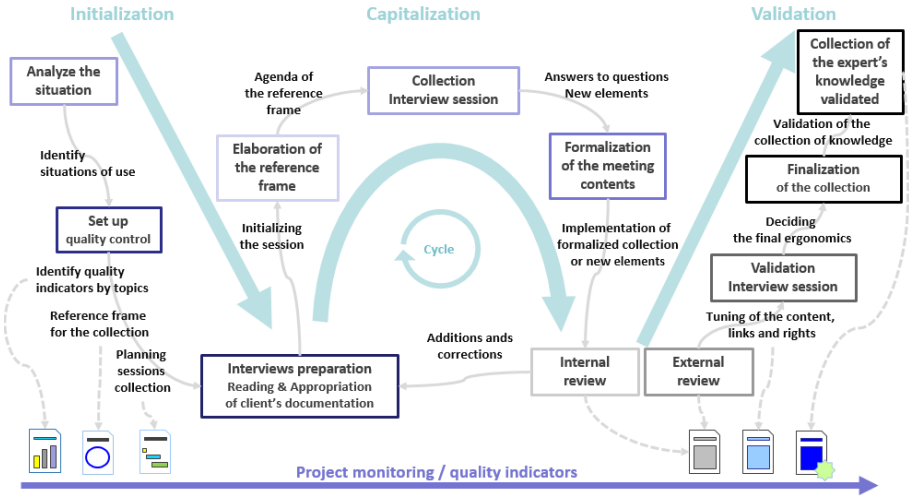

FIG. 2 – *The Omega cycle as explained in ArdansSas (2006b). It is the backbone of the MAKE method.*

4.2 Knowledge structuration

Whatever the chosen strategy and the technical solutions may be, it appears that the main challenge is to design models that can help the knower to structure his thoughts, and the knowledge manager to understand and organize them into parts. These parts called "knowledge elements", or articles, may sometimes be found in the Internet, in the intranet of the firm or even in a library. That what can't be found is the links between the knowledge elements, links that make sense and provide a lot of knowledge and understanding by themselves. The net of links between elements is named "Fi-Fi" net (from the French word fiche that means article). The rule is to set up less links as possible and to keep only the ones that seems to be mandatory. The same strategy can be used when creating the "Fi-V" net (V for vues in French), the net between the knowledge elements and the hierarchy of key words, as described by Berger and Cotton (2011a).

How much data (number of lines for example) can be stored in a knowledge element doesn't follow any strict rule. It depends on the article topic, on the field and on the feeling on what is just needed in order to understand and what can be put in another article. If the knowledge manager doesn't know if an article is too long it is admitted that if it takes more than one page when printed it is not handy.

The same strategy is used to evaluate the number of knowledge elements to create. The rule is to create as less knowledge elements as possible without obtaining too big ones at the end of the process.

The design strategy of the "Fi-Fi" net, the articles weight, the articles life-cycle and their relative number has never been called into question.

By contrast, three other aspects of the knowledge structuration were questioned since 2006:

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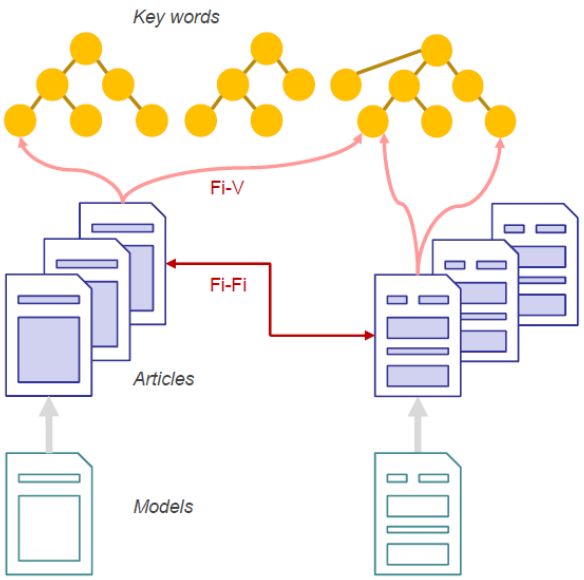

FIG. 3 – *Knowledge structuration in MAKE and AKM.*

the number of different structuration of articles, structuration of articles, and the number of key words that are used to reference articles. These key words are needed to lay down a language, a vocabulary and a basic grammar (hierarchy). They are more and more used as efficient search keys. Different types or classes of knowledge are used to categorize the knowledge elements. Their purpose is to help the knowledge manager and the knower to formalize the ideas and to keep a kind of schema on how to write down the knowledge. The knowledge manager will then create an article from a class and this article will inherit its structuration from this class. He will then write down the data from the knowledge he has acquired from the knower. In Mariot et al. (2007), a lot of default classes (sometimes called articles models) were set. Today, this strategy is not used anymore and a more flexible one is preferred: creating less articles models as possible and trying to start with classes that have proven their usefulness. The five classes that are mostly often used are Fundamental, Process, Feedback, Technical solution, and Document. Document class is only used to describe references (for instance books, scientific articles) in order to make a bibliography and to link some Fundamentals to their justifications. Fundamental class is used for instance to explain the minimal theoretical knowledge to understand the basic operating principles of some Technical solutions, or to understand a given theoretical field.

Classes differ at least from each other in their structuration. A class can contain some fields that are ordered and have a purpose. For example a class can have the following structuration: Title, Body, and Links section to link some references. It was found that designing models with too many fields is too complicated for the knowledge manager to write down the thoughts and for learners to understand the knowledge element. Sometimes, an ideas can't be

truncated the same way. For instance in Mariot et al. (2007), the Reference model has 9 fields with is considered now to be unusable. By contrast, an exception is the Process model which structuration helps a lot to order ideas: Title, Input, Transformation, and Output.

At the expense of a less number of classes, it has been observed the need to have a quite rich key words tree to discriminate articles.

In fact, articles models must be as permanent as possible in order to avoid the modifications of already created articles because of the modification of their model. Links between articles and the key words can evolve if the tree evolves. This is often the case during the capitalization phase.

One new concept has risen since 2006 that helps a lot the capitalization process: a holistic view of "Fi-Fi". This view is a graph that provides in one shot the entire structure of a data base. It is genarated by the GePhi program Bastian et al. (2009).

4.3 Knowledge validation

Each knowledge element must be validated by at least one knower. This can be tacked by the state of the workflow. Nothing has changed since 2006 and a workflow attached to a given article has been noticed to be one of the most important tool for knowledge validation and even articles management.

When capitalization is made with more than one knower, the strategy of validation appears to be one of the elements that size the project schedule. Here is a basic capitalization scenario: most of the articles are created as soon as possible (but left empty) in order to share the volume ok work between knowers. Each knower will work on these articles with the knowledge manager and when the former think it has reached a suitable level of maturity, the article is submitted for approval to the knower. Frome here, two strategies can be chosen: the validation of the population of articles is shared by the number of knowers, or a cross validation policy can be conducted. For a cross validation policy, the article is first validated by the knower that worked the most on it, and then given to the other knowers for an additional check.

The past ten years, it has been observed that multi-expert capitalizations is greatly valued by knowers as they want their colleagues to check, appreciate and to complete their work. This strategy enhances collaboration between people and generates a lot of discussion between knowers. The second point is that it can be assumed that a multi-expert validation quality is better that a single-expert validation. The main drawback is that it takes twice as time to validate if there are two knowers, triple as time if there are three knowers and so on. This generates a significant impact on the schedule compared to the "pure" capitalization cycle itself. Thus the validation strategy must be discussed when the project is designed.

5 Products

The aim of any knowledge management project is to create knowers. The model is based on the assumption that the knowledge transits from and knower to a learner, through a technical solution which is the knowledge vector. These projects can be compared as transmitting knowledge writing a story. The knowers tells the story, the knowledge manager makes the plan, the chapters, asks for the images, and writes it. Then for Ardans the project usually is over, except for firms that want to continue capitalize over time. Ardans does not train learners.

Given the high level of knowledge needed to understand what have been usually capitalised, the solution is not made to be trained, but made to be a reference. Learners may not use it on a daily basis but when they need precise answers to their question in a certain field. Access is made by learners in periods of intense learning, like a new product design for instance.

This technical solution is so important for the success of that kind of project that it can be called a product. The consultant will focus on the design of this product. Once the product is made, the firm can store it or share it. The Ardans team builds the solution but does not interfere on how long it will be stored or how the users will be managed to use it. The knowledge managers initiate the capitalization process and deliver the database. The human resources and the information technologies crews from the firm must apply the best policy to promote what have been built. The solution is built to avoid any training period to be able to use it.

5.1 Storage plan solution

The generation of a traditional knowledge book (paper book or eBook in printable format) seems to be left in favour of hypertext web solutions. These static websites are often written in pure HTML to improve lifetime decreasing software erosion. Usually, this solution is costless compared to the one proposed for the sharing knowledge solution.

However it has been observed that industrials has created an emergent use of this solution which is a mix of storage plan and sharing plan. Their strategy can be explained by the following scenario: they launch a capitalization project year y and a knowledge website is created on the chosen topic. They ask their learners to use the website as much as possible, in order to save the knowledge. Year y+n (n is a range between 3 to 10 years), they ask an update of this website ordering a new capitalization project on the same topic.

This solution gives them more flexibility in their wallet management. The drawback is that learners are not trained in a dynamic way, this implies that no knowledge is created and shared through the solution. If knowledge is created, data is not updated in the solution so there is no visibility of any evolution.

5.2 Sharing plan solution

This solution is technically much competitive and usually costs more. The Ardans' one is described in ArdansSas (2006a) and consists in a web based interface that can be displayed on any computer, linked to a database that stores the data. This web application supports the whole knowledge management project, from the capitalization phase to the learning phase including dynamic updates, and on the flow validation. These kind of solutions ensure that knowledge is saved, new knowledge can be created, written, and validated, then saved again by sharing and learning.

The main structure of this solution has never been questioned. However, some new functionalities have been added.

The interface have been duplicated to offer a simple one and a richer one respectively named "Simple search" and "Advanced search". The simple interface can be used by untrained people and have the basic functionalities. This give more flexibilities to the industrials.

The holistic data visualization is being integrated to the solution. For now, it is possible to export a net of chosen articles (articles and their "Fi-Fi" net) with their associated key words or not ("Fi-V" net) in a GraphML formatted text file. In recent years, data visualization

for holistic knowledge representation have proven its usefulness for knowledge identification (begin and mid-life of the project), knowledge cartography for strategic orientation (end of the project). When the data reflecting the knowledge is visually represented as a whole, in an understandable way, industrials qualify it as controlled acquired knowledge. The holistic view give to the industrials a tool to drive their knowledge transfer and database feeding policies.

6 Conclusion

The method has proven its robustness and nothing has changed dramatically since 2006. A collective drive of the different groups must be borne by the knowledge manager. Only a simplification of articles structures has been decreased in complexity.

The technical solutions were completed. The new functionalities match the new uses (tablets and different kind of screen sizes) and holistic graph representations were born thanks to software like GePhi. This software is presented by Bastian et al. (2009).

7 Discussion

The changes applied to the method makes it fit better industrial demand and cost and time constraints. But the "fitness function" suffers from a lack of visibility: although cost and time gains can be measured, it is not possible for industrials to evaluate scientifically if a solution is absolutely better than the previous one. It is not possible to set two series of projects on which two different methods are applied and then measure precisely differences with inferential statistics. Projects are given one at a time, and they have sometimes too much differences thus it is impossible to compare them on relatively independent variable.

For now, the only feedbacks are the mean return on investment over the years and the confidence of the knowledge manager that can propose solutions that seems to match better demand and existing products, to their point of view.

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Résumé

Ardans method ArdansSas (2006b) and technology ArdansSas (2006a) in knowledge management and especially in expertise capitalisation have set a lot of feedback over time. With a view toward ongoing improvement, what are the impacts of these feedbacks on the method nowadays? Put into practice in the industry, the return of investment of a capitalization campaign is inferred from the quality of the knowledge base delivered at the end of the campaign. Therefore, the method and the technology are intrinsically connected. How IT tools can assist with the quality diagnosis of the knowledge base?

A comparative study was conducted on the basis of the method Mariot et al. (2007) exposed at EGC'2007. This article sets out the results of the changes and improvements of the method, in conjunction with the latest technical and scientific development on the one hand, and the change of the industry needs on the other hand.