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### **Application of Knowledge Management to Intellectual Corpus Valorisation**

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Abstract: Within a company, the Intellectual Corpus notably include inventive activities. We propose to describe these activities in a new annual report, the Inventivity & Innovation Document (2ID), which represents a valuable deposit of new Knowledge for the company. We think that structuring and sharing this new knowledge within the company is mandatory in order to contribute to the innovation strategy by irrigating, with this new knowledge, transverse activities such as technical and technological watch, R&D planning, innovation management. So, we will define and characterize the Intellectual Corpus (and its link with the company Information System) and then the concept of inventive activity (and its justification methodology by means of Knowledge Management methods). We will show how the increase in Intellectual Corpus can increase the company Intellectual capital through its Knowledge value chain. The increase in value of inventive activities comes, on one hand, from the Knowledge actors sharing innovative experience and, on the other hand, from the contribution to the innovation strategy: the so-described process does belong to a virtuous cycle, based on meta-strategy.

Keywords: Intellectual property work, Intellectual assets, Knowledge Management, Inventivity, Knowledge share, Meta-strategy

## 1. Introduction

Main part of industrial company activity is described as global production, dedicated to tangible assets generation, generally without any innovation. Another part of its activity includes innovative components, liable to generate intangible assets within the Intellectual capital. Tracks of these intangible assets are made visible in the Information System through various media such as patents, study reports, papers, ... Among these tracks, an unusual medium, the Inventivity and Innovation Document (2ID) could be of some interest for companies as long as it represents a very valuable Knowledge deposit: it's easy to see that it materializes new knowledge issued by innovative experts with respect to the very top state of the art. So, we think that structuring and sharing this new knowledge within the company is mandatory to contribute to the innovation strategy by irrigating transverse activities such as technical watch, R&D planning, innovation management, ..., with this knowledge.

The objective of the current paper is to build a conceptual framework for the benefit of inventive activities organisation and definition of their mechanisms to be included in the 2ID. This paper will define the concept of inventive activity. Moreover, it will show how to use the 2ID to increase the Intellectual Corpus through a Knowledge value chain. This can be achieved through the identification of inventive activities, then through the definition of the writing process of this document and through the use of it as a means of collective innovation stimulation for the design engineering actors.

## 2. The project of an industrial company R&D valorisation

### 2.1. Introduction to the R&D concept

According to French *Ministère de l'Enseignement Supérieur et de la Recherche* (MESR, 2010), R&D means activities related to:

- 1°) Fundamental Research
- 2°) Applied Research aiming at finding *new* solutions to reach a *determined target defined in advance*
- 3°) Experimental Development devoted to the production of *new* elements (materials, products, process, services, systems, ...) or in preparation for their *substantial amelioration*

The activity of an industrial company will be mainly related to experimental development and secondly to applied research. Fundamental research does belong to Academic research establishments.

Considering its double accountable and scientific nature, implementing a R&D valorisation document could be a delicate task, on which our research work is focused.

### 2.2. Presentation of the R&D valorisation project

Determining inventivity assumes that exists a compatibility between an industrial logic based on Work Breakdown Structure and an approach liable to separate Research from Development activities. So, it's mandatory to develop a reasoned, exhaustive and reproducible process based on a robust but easy to run methodology. Research is mainly interested in discovering a technical problem not yet solved in the frame of current state of art of reference Knowledge, then in fixing it in determining the scientific contribution to the state of Knowledge. Industrial development starts from a scope of work, with requirements that must be simultaneously met in time, cost and performance axis: the industrial engineering expert is more familiar with technical project management than with science.

To efficiently build a correct Inventivity and Innovation Document (2ID), the industrial engineering expert (like other actors) must change his vision about his own activities, with a new vision based on scientific logic rather than on industrial logic, through a scientific formalised description of inventive activities. The proposed methodology aims at bringing to industrial actors the strictly necessary part of

academic culture required for the 2ID (training to the Research approach applied to solve technical problems, close to the patent analysis). This project aims at building a process based on how to make tacit Knowledge explicit through problem solving approaches having led to a new conception. We want to tie a strong link between the methods of KM and the Innovation actors who are the company technical experts (Inventivity part) but we also want to extend the quality of Innovation actors to other people within the company (Innovation part), whose contribution will have generated a real innovation.

The main objectives of the 2ID valorisation is to make the Technical Direction staff aware of the stakes of Knowledge specific to the company. They must understand that the 2ID is a value deposit (in the sense of KM and Intellectual Corpus) for all the R&D and Innovation actors. This value deposit must be exploited to improve all the technical transverse activities (internal technical communication, technical watch, R&D planning, Innovation management). This pragmatic application of the 2ID can only further the promotion of R&D either among the peers (who can be gratified) or among the company General Direction.

One key aspect of the research project consists in integrating the mechanisms of inventive activities into the Information System and in taking benefit of its scientific synthesis according to its dialectic sense.

In the present paper, after the introduction (Paragraph 1), paragraph 2 describes the research project. Paragraph 3 aims at defining and characterising the Intellectual Corpus and its links with the company Information System. The concept of inventive activity is analysed in paragraph 4. Articulation of the Intellectual Corpus and Knowledge value chain is discussed in paragraph 5. Paragraph 6 is devoted to the justification of inventivity. Valorisation of inventive activity is discussed in paragraph 7. Conclusion is presented in paragraph 8.

### **3. Intellectual Corpus & Information System**

The introduction in the previous paragraph emphasized the tight association of finality and novelty of the R&D activity. It admitted that this novelty could be total or partial, if it were extended to some substantial amelioration. This association refers to an Intellectual property work intended to be included into the Intellectual Corpus. The next paragraph aims at illustrating how this concept is materialized by including its container into the Information System according to the systemic model of Intellectual Corpus.

#### **3.1. Intellectual property work and Intellectual Corpus**

The French Intellectual Property Code states that the author of Intellectual property work has an exclusive right of ownership arising out of its creation. This right includes moral rights on one hand and economic rights on the other hand (Article L 111-1). By essence, this intangible property is separated from the tangible property of the physical support of the Intellectual property work. So, the concept of Intellectual property work emphasizes the duality between the content and the container. The content is immaterialised thanks to its pure intellectual nature. The container belongs to the sensible world, it can be transmitted for all kinds of transaction. The content belongs to the Intellectual Corpus and the container belongs to the Information System.

Ermine (2008) defines the Knowledge System of an organisation as a set of Knowledge resources. He points out how to switch from a *Resource Based View* (RBV) approach to a *Knowledge Based View* (KBV) approach by considering Knowledge as a basic resource: here we focalise our attention on the general process of creation. This process is based on Knowledge specially mobilized for the creation of Intellectual property works. This particular Knowledge forms a part of the Knowledge System that we will define as "Intellectual Corpus".

#### **3.2. Intellectual Corpus and Intellectual capital**

Intangible capital is currently used today to refer to all the intangible elements the possession of

which is liable to bring an economic advantage to a company on its market. (Laperche, 2001 ; Bounfour, 2006a ; Bounfour 2006b). According to Breesé (2004), these elements can be seen as intangible assets.

So, we can distinguish:

- The intangible assets which are materialized and made explicit through a tangible support, having given intellectual property rights either registered (patent rights, trademarks, ...) or not (copyrights including moral rights and economic rights)
- The Intellectual property works which are tacit, not formalized and non appropriable by the organisation

Intellectual property works give intellectual property rights (IPR). These IPRs form a part of intangible assets, which we will call Intellectual capital.

### **3.3. Systemic model of Intellectual Corpus**

We want to propose a “creative system” within the company, generating Intellectual property works which will be accumulated in the Intellectual Corpus and which will generate new value within the Intellectual capital. Our model is focused on the Intellectual Corpus domain, not on the Intellectual capital domain.

As the Intellectual Corpus acts as a sub-system of the Knowledge Corpus, the model proposed here is based on the AIK model proposed in Ermine (2008).

- 1) The Knowledge actors [A] create Intellectual property works. They are considered as cognitive personalities, owning their own cognition corpus. However, they are closely inter-related, so that the cognition corpus of the Knowledge actors is not limited to the addition of everyone
- 2) The Intellectual Corpus [L] is the system which includes the cognitive corpus of all the Knowledge actors and which generates Intellectual property works. It includes creative works generating moral property rights: the author rights are based on the fact that, as a conscious and thinking human being, the author owns the very principles of his mind that he mobilizes in order to create an original work (original meaning characteristic of its creator, as emphasised by the legal expert). Creation does exist since the creator displays the principles of his mind which he mobilizes in order to generate an Intellectual property work which is an integral part of his personality. In addition to this individual dimension, the interactions between the Knowledge actors with their personal cognitive corpus collectively generates Intellectual property work which is the very object of our research
- 3) The Information sub-System [I] related to Intellectual Corpus, which is the explicit materialisation of the Intellectual Corpus. It's the part of SI which includes the supports of the Intellectual Corpus such as patents, publications, study reports, supporting file for Research Tax Credit, ...

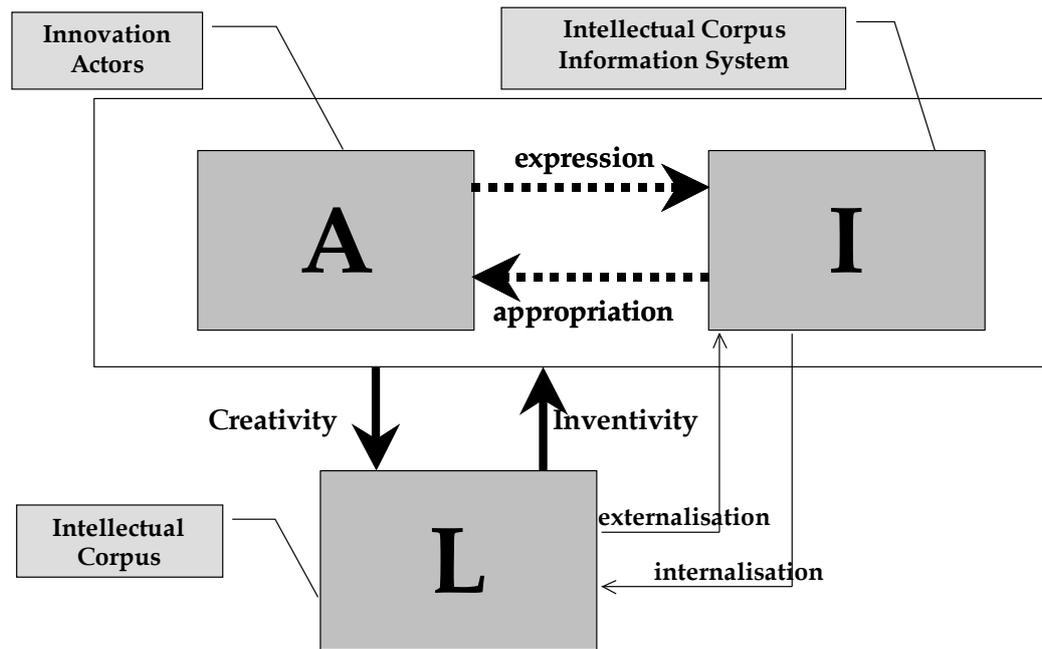


Figure 1: The AIL systemic model of Intellectual Corpus

Flows between [A] and [I] can easily be defined:

- Expression: between [A] and [I], Intellectual property work can be materialized as a physical support
- Appropriation (according to the psychological but not to the legal sense): between [I] and [A], we deal with the analysis, the understanding, the global appropriation of the existing content of the Intellectual Corpus

The flow circulation between subsystems [A] and [I] will act as a catalyst with respect to the creation which shows itself as flows from the sub-system [A, I] towards Intellectual Corpus [L]. The flow entering into [L] describes the capacities allowing creation (*creativity* flow). The flow going out of [L] consists of the instantiation of the capacities through the creation of Intellectual property works liable to be materialized by information supports (*inventivity* flow).

We didn't represent the external flows, assuming that they influence the cognitive corpus of any Knowledge actor, who owns specific personal and professional knowledge that he got *in situ* (training, professional experience) or *ex situ* (conferences, seminars, networks, ...).

To sum up, it seems that putting emphasis on the creator involved in his own creation is a necessary condition to stimulate his inventive activity. Furthermore, as the company Intellectual Corpus is intimately linked to the personal Intellectual Corpus of all the experts, encouraging the creation of an Intellectual property work demands investments on the cognitive profile of the experts and, more globally, on Knowledge. Managing the inventive activity means managing experts and Knowledge.

The research consists in working out conditions and processes which will promote the inventive activity.

#### 4. « As usual » and inventive activities

The previous paragraph insisted on the need to divide R & D activities between non inventive and inventive. The current paragraph aims at characterizing both of them. Inventive criterions will be

presented in paragraph 6.

## **4.1. Creativity**

### *4.1.1. Creativity in broad sense*

A definition of creativity admitted by numerous researchers is the ability to get a production which must be simultaneously new and matched to its context (Amabile, 1996 ; Barron, 1988 ; Lubart, 1994). The creative action is supposed to request an intentional and arduous work, the realization of which must include numerous difficulties (Lubart, 2003).

According to Altshuler (1984), creativity can be mainly seen as an ability to solve problems, which are defined as a gap between a planned and a really stated situation (Popper, 1994). A problem is called « as usual » if its resolution process can easily be found by means of good old solutions tried and tested in analogous contexts. A problem is called “not as usual” or creative if a substantial part or the whole resolution process are unknown.

As a conclusion, general definition of creativity can be seen as the ability to solve an unusual problem in a new way perfectly matching the context.

### *4.1.2. Creativity and Knowledge*

Taking Palo Alto School's point of view, according whom creativity is an ability to change one's perception, we will define creativity as the ability to see things in a different way and to drop the existing representations.

So, creativity is a change in perception which can generate a new idea: creativity lies in a turn of mind, in a state of mind. According to our assumption, the change (idea generation) gets cognitive components (according to a process involving tacit Knowledge) and social components (according to a process involving Knowledge communities). Creativity aims at modifying Knowledge based on erudition, at revising and recombining Knowledge by giving them new senses and new values. In the ALL model, creativity is seen as a flow from [A] to [L] located in the posture domain, but without tangible production in [I].

## **4.2. Inventivity**

In literature, we can only find few definitions of inventivity (Rouquette, 1973). According to Bardin (2006), the inventivity can be described as a «new production capacity related to any domain of human activity ». Taking Palo Alto School's point of view (Watzlawick, 1974), we will define inventivity as the ability to change the reality of things or the elements of a system.

So, we can see that inventivity consists of the ability to create and to transform reality, to materialize a new idea carrying change and liable to find an innovation traceable in the Information System. According to the ALL model, inventivity is a flow from [L] to [I], located in the action domain.

## **4.3. « As usual » activity**

Using the previous paragraph, we can define the « as usual » activity, without any negative connotation, as the activity following the use or the combination of existing Knowledge and accessible without any creative effort to the man of the art.

At this point, we are fully able to discriminate inventive activity from “as usual” activity, thanks to conceptual definition of both. Before presenting inventive criterions (in section 6), the point is now to link creation and Knowledge value.

## 5. The Knowledge value chain

Paragraph 2.2 stated that the 2ID is a value deposit, according to Knowledge and Intellectual Corpus. Paragraph 5 aims at introducing the Knowledge value chain concept and at showing that the project generates a new vision where the approach based on non contextual Knowledge takes place of the contextual approaches usually based on products and services.

Integrating KM into a company illustrates the move from the company ability to manage its Knowledge Corpus to its ability to use this Knowledge to help its innovative employees to develop inventive competences and to transform these individual competences into a product / service innovation portfolio in line with the company strategy. These mutations are described in a value chain, called Knowledge Value Chain (KVC : figure 2).

There are two ways to build a Knowledge Value Chain. The first one is directly inspired by the famous Porters' Productive value chain (Porter, 1985): it's can be described as a series of activities which regard Knowledge (Create – Code – Share – Transfer – Identify – Evaluate, ...): see Wang & Ahmed, 2005 for example. The second way can be described as a series of cognitive activities which influences the processes related to the company Knowledge processing. The most famous one is the DIKW (Data – Information – Knowledge – Wisdom) chain which describes all the necessary changes to move from sensible reality to data, to information, to knowledge and to wisdom. We selected "individual wisdom" to represent competence and "collective wisdom" to represent core competence. The "individual" wisdom is defined as the capacity to think and to act by using knowledge, experience and comprehension (Individual competence). The "collective wisdom" is defined as the ability of an organisation to act according to a shared strategic vision. A full analysis of this chain is available in Rowley (2007).

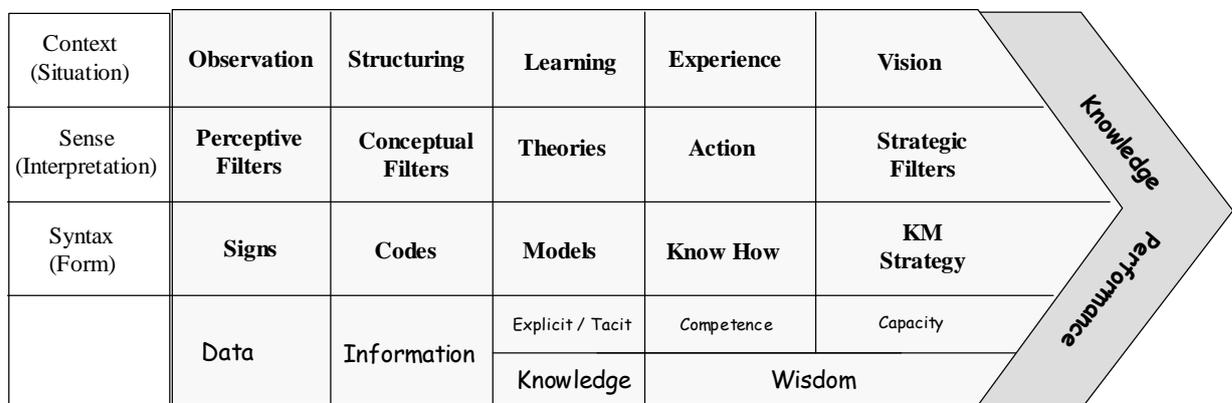


Figure 2: Change processes in the Knowledge Value Chain

We focus here on to the second type of value chain, as a collection of Knowledge creation processes fully embedded in the company innovative activity.

The successive changes in the Knowledge Value Chain can be described in the following simplified way (figure 2):

- Reality into data: receiving signals through perceptive filters (observation activity)
- Data into information: encoding data though conceptual filters (structuring activity)
- Information into knowledge: building theory-based models (training activity)
- Knowledge into competence: developing a set of expertise for action (actionable know-how in experience context)
- Competence into capacity: building a Knowledge-related strategy through strategic filters (strategic alignment within a global vision of the organisation)

For each step in the chain, the organisation raises the level of its cognitive capacity, if it puts suitable management tools in place. Only the chain output, which results from a well-controlled innovation process and consists of a portfolio of products / services, can be transformed into commercial value. This final value comes from the accumulation of intermediate values which are essential for its creation: data collection, information structuring, discursive organisation of information, training and strategic analysis. A description of this chain is given in figure 2 and figure 3.

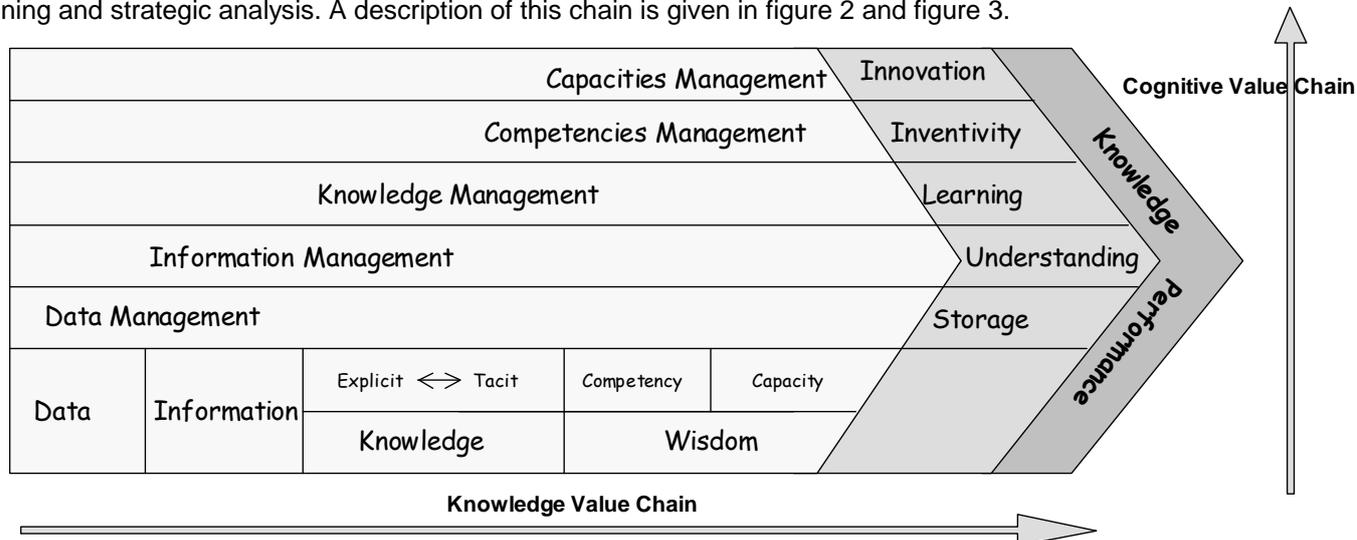


Figure 3: The Knowledge Value Chain as advance of the company cognitive capacities

First step consists in building its organisational memory by storing and processing data. Then, use of processes and of information processing tools creates sense for this data accumulation (used for operations or for decisions). KM makes the company become learning, because it optimises the use of available information to create, acquire and transfer knowledge. This knowledge is embodied in people through action. These people get experience and they are able to have an intelligent behaviour: react in an adapted way to new situations and produce inventive solutions when coping with current life problems.

This research aims at providing methods and tools to optimise some changes in this Knowledge Value Chain and to enhance the innovative capacity of the company.

This mechanism is still more pregnant within R&D activities, but in order to update valorisation, it's mandatory to describe the trajectory of inventive activities within the value chain, in terms of increase in competences, capacities and individual & collective wisdom.

Next step of the research is devoted to the justification of inventivity.

## 6. Proof of inventivity

### 6.1. Principle of inventivity criterions

A 2ID only implies inventive activities. As inventivity can only result from a creativity flow (according to the AIL model), it can be defined as characteristic of an activity generated by the organization facing such a technical problem that it cannot be solved by the man of the art within the current state of Knowledge.

The above principle states that, at the very moment when the problem is formulated, no solution can apply to it as long as it raises new difficulties: the technical problem is reputed to lie in scientific and/or technological uncertainty, so that no diagnosis can be made before setting up a complete state of the art including Knowledge accessible to and actionable by the man of the art in the concerned field.

Facing a non yet solved problem requires the definition and launch of specific investigation works (inclusion in the inventive field) which must demonstrate a substantial and significant gap from the current practice in the concerned field: these investigation works must demand such an expertise that they require a creative and inventive support from experts well beyond the current know-how of the profession. By carrying over these innovative tasks, the experts will generate new and inventive Knowledge, the arrangement of which will bring a solution to the technical problem (inclusion in the state of the art of the technical community). The originality (in the Intellectual Property sense), novelty and inventivity of this Knowledge as well as the increase in the state of the art of Knowledge represent as many discriminative estimators.

## **6.2. Proposed methodology**

The proposed methodology aims at bringing to industrial actors the strictly necessary part of academic culture that is mandatory to build Inventive and Innovation documents.

It consists in applying an usual approach of novelty and inventivity proof (similar to the patent identification) to the resolution of technical problems:

- Set the problematic with respect to the community state of the art
- Establish the community state of the art before setting the problematic and after its fixing
- Prove that the activity is not limited to a simple arrangement of means or Knowledge but that it represents a creation

This approach is not natural for a design engineer, who is used to cope with performance criterions. In terms of KM, this inventive criterion results from a problem solving approach which remains generally tacit in experts' mind. The methodology uses a Knowledge Engineering method (Ermine, 2008) to make the mechanism explicit and to include in into the 2ID.

Next step of the research consists in demonstrating that, thanks to the 2ID, the end of inventive project in its specific technical domain is the beginning of a new life in the Knowledge domain.

## **7. Valorisation of inventive activities**

### **7.1. Introduction**

One objective of this up stream part of the project is to make Technical Direction staff aware of the 2ID being a value deposit in terms of Knowledge for all R&D actors and decision makers. Numerous authors already studied the application of Knowledge Management to the realization of the company organisational goals (Avenier, 2007 - Ferrary, 2006 – Rojot, 2005 - Tidd, 2006).

According to the Knowledge chain value described in paragraph 5, writing the 2ID increases the individual cognitive capacities of experts thanks to the description of their inventive Knowledge. Moreover, having explicit documents is a mean to share innovative experience. Finally, the whole 2ID describes the annual inventive production of a given organization. This material could feed the transverse technical management activities, such as technical watch, R&D planning and innovation management.

### **7.2. Creativity stimulation by means of the 2ID**

Proposed methodology is based on the stimulation of experts' creativity through the confrontation to a Knowledge Corpus which synthesizes the company Intellectual production (Saulais, 2011). This corpus is fed with cognitive maps which describe a technical object through ten Knowledge domains. These domains include constitutive elements based on a physical description

(Domains 1 to 6), then the physical medium of operation (7). The last three domains include models (8), computational and processing operators (9) and system architecture (10). Each domain can be seen as a complex system (Bertalanffy, 1968), which is classically described according to systemic points of view: functional (what the systems does), structural (what the system is), applicative (what the system is designed for). The genetic aspect (system evolution) is not analysed here. For each Knowledge domain, the intellectual production is evaluated through ten criterion. Figure 4 gives an example of cognitive map for the Algorithm domain. Intellectual production according to each point of view will be evaluated thanks to the criterions, either quantitative (related to an inventory of Intellectual property works) or qualitative (related to the appreciation of the deployed inventivity).

The point here is to apply this methodology based on the scientific synthesis of the 2ID through inventory, novelty and inventivity, state of the art criterions, ...

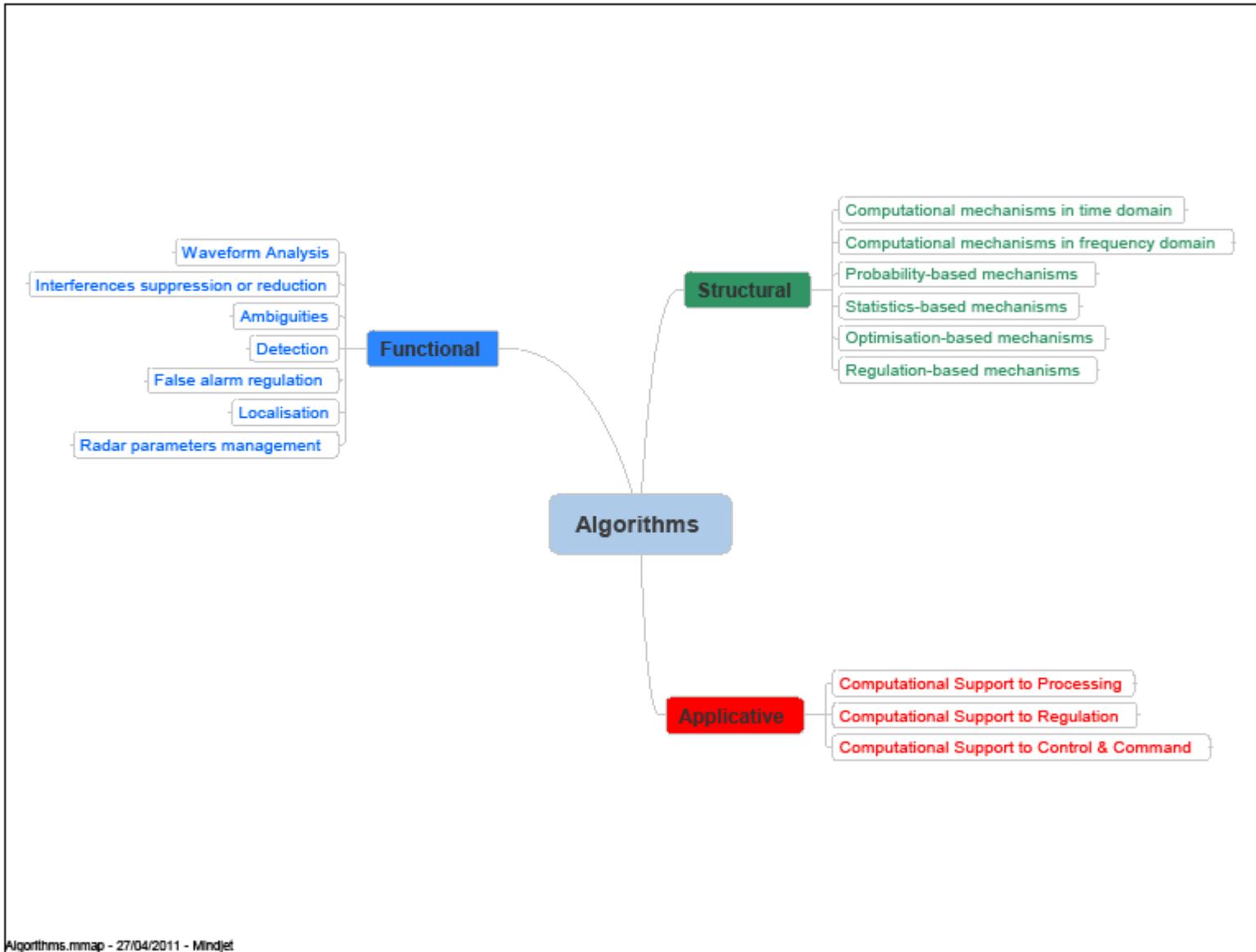


Figure 4: A cognitive map of Intellectual Corpus according to one Knowledge domain

### 7.3. Process description

According to Saulais (2011), creativity stimulation process is applied to the company experts through six steps:

Step 1 : As soon as cognitive maps and intellectual production evaluation diagrams are ready for every domain, results per domain are shown to a selected expert. He is asked to react to the synthesis of his domain by referring to his own knowledge. Then emerge numerous critics, statements and proposals of evolution in the concerned domain

Step 2 : Results from step 1 are compiled and submitted to all experts. Every domain expert will defend his own analysis and proposals against all the other experts. Step 2 results in a set of consensual proposals per domain

Step 3 : The set of proposals is again submitted to all experts to score a priority level

Step 4 : The proposals with priority level will be revised by alignment with the company strategy. This step is collectively carried over by all experts assisted by the Strategy Director

Step 5 : The results of strategic alignment with justifications are transmitted to all the R&D actors

Step 6 : All the proposals issued from step 5 are translated into a medium-term or long-term R&D plan, with a set of recommendations to feed transverse technical strategic

This process is currently being tested within a large international company. In this experiment, audience of step 3 to step 5 is extended to technical direction staff.

## 8. Conclusion

By showing the strong link between inventivity and KM, the scientific interest of this research project appears in the robust theoretical frame able to structure inventive activities and their mechanisms to be described in the 2ID, for company internal use. Besides, this research project introduces an original vision of a company R&D activity, where the approach by non contextual inventive Knowledge takes place of usual contextual approaches through products and services.

The interest for the company consists in getting an operational methodology liable to make its culture evolve in the inventive activity domain, mainly in transferring scientific culture from academy to industry. This project aims at building a first process based on how to make tacit Knowledge explicit through problem solving approaches having led to a new conception. Then the results issued from this first process are to be applied to a second transverse strategic process monitoring all the technical activity through an organisational learning approach.

More generally, we can see that the benefit expected in terms of KM generates a virtuous cycle which strongly motivates a deep and accurate description of results and mechanisms of inventive activities: the so-described loop not only helps the progress within the company Knowledge value chain, but it also generates intangible assets and it is finally itself auto-gratifying.

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