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An Integrated Conceptual Environment based on Collective Intelligence and Distributed Artificial Intelligence for Connecting People on Problem Solving

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ABSTRACT

This paper aims to analyze the different forms of intelligence within organizations in a systemic and inclusive vision, in order to conceptualize an integrated environment based on Distributed Artificial Intelligence (DAI) and Collective Intelligence (CI). In this way we effectively shift the classical approaches of connecting people with people using *collaboration tools* (which allow people to work together, such as videoconferencing or email, groupware in virtual space, forums, workflow), of connecting people with a series of *content management* knowledge (taxonomies and documents classification, ontologies or thesauri, search engines, portals), to the current approaches of connecting people on the *use (automatic) of operational knowledge to solve problems and make decisions based on intellectual cooperation*. The best way to use collective intelligence is based on knowledge mobilization and semantic technologies. We must not let computers to imitate people but to support people think and develop their ideas within a group. CI helps people to think together, while DAI tries to support people so as to limit human error. Within an organization, to manage CI is to combine instruments like Semantic Technologies (STs), knowledge mobilization methods for developing Knowledge Management (KM) strategies, and the processes that promote connection and collaboration between individual minds in order to achieve collective objectives, to perform a task or to solve increasingly economic complex problems.

1. Introduction

KM is one of the pillars that support an intelligent organization, but companies still face difficulties in implementing KM initiatives, and much less sustain it (Fagiolo et al 2003, Mazilescu 2009a, Mazilescu 2009b, Mazilescu 2012, Müller 1996, Qian 1992, Schwartz 2006, Tassier and Menczer 2001, Tesfatsion 2006). Companies have focused their efforts on what appeared to be the most direct approach, uncomplicated, like KM, and set aside the issue of intellectual cooperation, which appeared to be much more complicated to implement than electronic document management software. CI and KM are highly interconnected. There cannot be one without the other. Both are needed. CI supports KM by the fact that the primary activity of reflection is to generate innovative ideas and information. And KM supports CI, since the reflection is based on what has already been capitalized in the organization. Even if CI and KM complement each other, creating and sharing information always lies in the human interaction. We learn from others, and we all share our knowledge with others. Knowledge capitalization and sharing are acts of intellectual cooperation. Sharing information is actually one of the three key elements of CI. No KM initiative will last without a collaborative agreement. There can be no KM without CI (Eleftherakis and Cowling 2003, Van Arle et al 2001, Vriend 1995, Wsterhoff 2004).

Intelligence refers to the ability to acquire and rationally apply knowledge in different economic systems, business processes and decision making (Mazilescu 2010, Nebel and Bäckström 1994, Ponnurangam and Uma 2005, Walker et al 2004). Given this brief definition of intelligence, were created Knowledge Management Systems(KMSs), which include different and varied problem-solving skills. KMSs belong to this area, and are based on DAI solutions, which aim to formalize intelligent action. A rigorous definition for Knowledge Based Systems (KBSs) is mainly based on a series of logical foundations. Logics is a discipline that grew out for different reasons and with objectives that differ from those specific to DAI. Real-time calculation is an area of intense research, since the accuracy of KBSs operation in a dynamic and distributed environment, depends not only on its implementation logic, but also on the temporal aspects involved (if the company is operating in a Real Time Environment- RTE). Such systems are subject to various complex time restrictions, with various levels of granularity of the time. Temporal knowledge is a key issue for a large number of applications (real-time planning, management and business process management, and dynamic

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situations management). A KBSs must have a reasoning capacity to consider a series of events that can occur: interruptions, limitations on processing time, synchronous and asynchronous nature of the new events' occurrence. Considering time must highlight two complementary aspects: temporal information management and formalizing the temporal reasoning on time and in real time. Some approaches are based on numerical models and other on symbolic representations of time (Mazilescu 2011, Mazilescu 2012, Omar 2008, Tesfatsion 2001, Tobias and Hofmann 2003, Tumminello et al 2005).

Nowadays, KM is not a task that inspires pride. KM is often put into effect by people that are not expected to reflect, but expected to support those who do it. Being a fundamental activity, essential for the functioning of an organization, the KM should be everyone's shared responsibility, not left just to some people. This is why KM should be included in the performance evaluation system of an organization (e.g. Annual review) and in the recognition system (such as remuneration, bonuses, non-financial recognition). If one will contribute, to capitalize or to exploit knowledge, to offer ideas, he must be aware of the fact that he will get something in exchange (social or financial recognition), and will know how KM will use his efforts or what will be their impact on the company.

In section 2 are considered the conceptual relations between different types of intelligence to define an unified intelligence environment within the organization, based on operational knowledge (often inaccurate), called UIFOLOK (Unified Intelligent Framework at Organizational Level based on Operational Knowledge) stressing especially the connection between DAI (the key element of semantic technology), CI and specific knowledge in the field, which is, according to the approach presented in this paper, the conceptual basis of Intelligent Systems in Economy (ISE). In section 3 we present the contribution of STs in supporting ISE development, future technologies that allow people and computers to create, discover, represent, organize, process, manage, reason, display, distribute and use imprecise meanings and knowledge to meet various business, personal or social goals. Operational knowledge or domain knowledge are of great interest in developing intelligent KMSs and related practices, and are based specifically on individual competencies, on the experience gained by workers using knowledge, in a skilful way, in their daily work (Mazilescu 2012). Section 4 presents the most important conclusions related of this important actual debate.

2. The features of the Unified Intelligent Framework at Organizational Level based on Operational Knowledge

The problem we formulate now refers to the existence of a method to structure various forms of intelligence in a unified intelligence framework within the organization, based on UIFOLOK operational knowledge, with solid semantic interpretations and practical applications, the unifying element being the operational knowledge. Reformulated, the problem suggests the definition of the links between different types of intelligence, for understanding the relationship between them and secondly, to clarify the role and place of KM in the synthesis of intelligent systems with applications in economy. Solving this problem, in the context of the present work, is an important step to achieve the objective outlined in this paper, namely to develop a conceptual framework based on which can be developed intelligent systems rooted in KM. It is proven that change management, the culture and individual transformations, are, among other, important components that lead to changes that enhance organizational intelligence. From any perspective we look at the organizational structure, there is ever obvious the existence of various types of intelligence, which contribute to defining it as an intelligent organization, such as AI, Business Intelligence (BI), Competitive Intelligence (CI), Collective Intelligence (Collective Relationships Intelligence - CRI), Strategic Intelligence (SI), Emotional Intelligence, etc.

KM is the next layer of the proposed structure for UIFOLOK, intimately connected to AI. Some important issues regarding the definition and characterization of KM have already been analyzed in (Fagiolo et al 2004, Mazilescu 2009b, Mazilescu 2012, Müller 1996, Ponnurangan and Uma 2005, Tesfatsion 2001, Van Arle et al 2001). Many organizations have accepted KM as a particularly important component in their human capital strategy. For example, the U.S. Office of Personnel Management recommended *leadership* and *KM* as the pillars of strategic human capital management within the governmental organizations. An impressive number of researchers and practitioners have studied and created various techniques and methodologies for developing strategies based on *knowledge mobilization*, as well as various plans to implement these strategies, in the form of KM Systems of current and future generation. New generation systems must solve a series of *dilemmas* currently existing at the level of KM practices and systems, such as the tension between distributed processing of knowledge-based tasks (in *groups of organizations*, *communities of practice*, *social networks*) and the technologies used, the serious issues related to the semantic of all knowledge in the real time creation and operating processes, a clearer definition and acceptance of the KM, as it is practiced within various organizations that are becoming increasingly complex (in the form of virtual organizations), accessing knowledge in various *strategic alliances*, a foremost process even before the knowledge acquisition, etc.

Competitive Intelligence (CI) is the layer located between BI and CRI (Collective Intelligence) in the context UIFOLOK's framework. The more the Internet breaks a series of traditional barriers between enterprises' businesses, the more dramatically increases the competition for improving product development cycles and the company's profit is often unpredictable. CI can help any company to become an impressive competitor in a particular industry or on a specific market segment. CI is the set of procedures for analyzing information in a continuous process. CI is not simply a set of methods for determining information about competitors. CI focuses on generating procedures (intelligent) to support a series of decisions that relate to future events. Clearly every company needs information about competitors, but needs, at least equally, to know (therefore information or knowledge) a number of issues about the industrial or business environment to which it relates. To operationalize the CI within a company, should start with a very clear purpose, meaning it needs to be answered to a question such as: "Which is the most important information that my company needs for setting a specific competitive strategy, to understand competitors' strategies, and how to effectively obtain this information which is subsequently used in making concrete decisions." Knowledge is value, intelligence is power. The authors emphasize in the same work that CI allows getting what you need, based on what you know. It is also examined the notion of *generating a competitive capital*, in the sense that a firm is on track through what they do, i.e.: i) do you know everything you need to know before taking a certain strategic decision?; ii) do you know where to look for what you need to know?; iii) do you know what to do with the information once found? All these questions can be answered by developing and implementing a KMS. Bret Breeding argue the convergence between IC and KM. The synergy between these two fields supports the determination of knowledge flows within the organization and allows a better assessment of its current state, what needs to know and how to operate.

Strategic Intelligence (SI) is an aggregation of the aforementioned types of intelligence, being located on the layer that wraps (at least conceptually) this hierarchy of intelligent components. SI must provide value-added information and knowledge to support the organization in making the best decisions. SI is most often used in military or defence, to make high level decisions. SI is categorically different from operational or tactical intelligence, which are forms of low intelligence. In the economic field, SI has roughly the same connotations as in military, the difference relating to how to practically use it in this area. More specifically, the focus is on answering the question "how well can be set the organization to meet future challenges and opportunities, in order to maximize its success?" UIFOLOK intelligence unified framework aims to bring together different types of intelligence, starting with DAI in the UIFOLOK core and continuing with KM, BI, CI. It is not necessary that KM should include DAI, at least from the traditional managerial perspective of KM. It has been proven in the recent years and especially for the coming years, that DAI (by the outstanding achievements in this field, namely the great capacities to resolve very complex problems) has a huge potential in supporting the development of advanced KMSs, based on *STs*, much closer to the companies' needs in supporting various business processes.

Successful manager needs more than native intelligence. Consequently, the scientists have begun to study the skills of those who succeeded and the reasons why the others have failed. The conclusions were simple and of common sense: interaction or the talent to make people follow you is the path to success. Emotional intelligence is "the ability to perceive and express emotions, to assimilate emotion in thought, to understand and judge based on emotions, and to regulate own and other's emotions." Why is emotional intelligence so important for business environment? Emotional intelligence plays an important role among all the factors that influence the effectiveness of a person or organization of which it is part: relations with the boss, uncertainty, uncertainty, decision making process, job motivation and satisfaction, keeping talented people within the organization, etc. Leaders and managers need a developed emotional intelligence. They interact with a large number of people and represent the organization in front of the public. Every time we make a choice we use our emotions.

Collective intelligence is the intelligence of connections and relationships. Some authors define it as an intelligence that connect a complete brain, a symbiotic man, or a relational intelligence. In essence, collective intelligence represents harmonious connections or relations. These connections develop collaboration. Thus, the collective intelligence refers to the ultimate effect, the materialization of intellectual collaboration. The factors that hinder KM and collective intelligence are almost identical: (1) Culture, when oriented towards power and status rather than towards sharing and responsibility; (2) Verticality: pyramidal organization that divides the company into compartments, in a non-colaborative war; (3) Resistance to change: fear of the unknown and novelty, risk and comfort aversion, and safety of old habits; (4) Inadequate technology. Information society gradually transforms industrial and commercial companies into intelligent companies. Those that do not evolve in this direction may not keep pace with the society and go bankrupt.

3. STs automate the rational use of knowledge in KMSs

In the last four decades has been a dramatic change in approaches to semantic technologies, meaning those technologies that incorporate increasingly more knowledge-based systems (KBS). Uncertainty, inaccuracy and imprecision were attributes with rather negative meanings. A scientist which could not define exactly one statement was not seen as a "real" scientist, and uncertainty was considered as a disturbing element in the process of modelling, being avoided as much as possible. The only uncertainty accepted theory for the study of uncertainty has been the probability theory, in its interpretation based on the frequency of occurrences of an event, and restricted to the situations where the law of large numbers was valid, while uncertainty was associated with a random character. It was accepted that the uncertainty and imprecision, in the generic sense, are part of the reality that we cannot change and obviously even of the people's everyday language. The real world is complex: complexity caused by uncertainty arises in the form of ambiguity. From these observations was born the question why people, however, fail to reason about real systems? The answer is closely related to the fact that people have the ability to reason approximately about the behaviours of complex systems, keeping only a generic meaning of the problems. This generality and ambiguity, however, are sufficient for understanding complex systems.

KMS are guided by the goal, and seeking a problem's solution in its area is their key feature. It can be observed a quasi-continuity relationship between the tasks specific to a problem domain, characterized by sufficient information or knowledge to achieve an objective (*case 1*), and those specific to a domain in which knowledge is insufficient, contradictory, uncertain or imprecise (*case 2*). In the first case there are explicit algorithms that convert the input data set into a corresponding output value. There is no notion of search or backtracking. Any deviations during the execution are uniquely associated only with the dependencies between data, this being the case of conventional real-time tasks. In the second case, either tasks features or the interactions with the problem domain, are not fully known. There are needed heuristics for searching in the problem space to determine a satisfactory outcome, and there are large deviations in execution times. Because of these irregularities associated with the problem solving tasks, traditional developing methods for real-time systems cannot be directly applied in the second case. Increased knowledge involved in problem solving can be applied to reduce deviations due to searches. Search manifests on the two levels of solving a problem: the level of knowledge retrieval and the level of application-specific knowledge or problem space (Mazilescu 2012).

A classification of the system in terms of complexity and thus of useful theoretical and practical means for their modelling can be summarized as follows: 1) for low complexity systems, are sufficient the formulations based on exact mathematical expressions; 2) for systems that are more complex, but for which there are not sufficient significant data, neural models provide a strong framework to reduce uncertainty, based on learning the forms from available data; 3) highly complex systems for which there is a limited number of data, and available information is ambiguous or imprecise, fuzzy logic-based reasoning is a way for understanding the system's behaviour, by carrying out certain operations on various symbolic structures associated to observed inputs, output states, intermediate variables that support chaining certain inferential processes (Mazilescu 2012).

The approach in hand falls in third category according to above classification, and is a part of KBSs approaches. Its scientific goal is to develop a KBS-type KMS, in which the inferential system is based on fuzzy logic. The system developed in this respect is a planning expert system, embedding and controlling discrete logical events, and using compiled fuzzy knowledge. The proposed basic time meta-equation covers the complexity and real-time term (potential and reasoning on time). Are highlighted the main contributions and limitations of this meta-equation's solution for a practical example of KBSs as an AI-based KM system, which complies with the formalism of representation and processing factored knowledge, and further possibilities to integrate such an AI system into a structure of real-time system with application in the field of intelligent business.

Developing applications for supporting real-time businesses should be subject to causal specifications of these systems, because not respecting time restrictions may lead to their malfunctioning. Real-time calculation is an open research area both in computer science and in designing current technologies. It depends not only on the logical correctness of the results, but also on the time they are made. Real-time systems play a vital role in society and cover a wide range of applications, including experimental laboratories management, technological processes management, nuclear plants, aviation and robotics, military systems. Real-time systems are complicated and expensive, and time restrictions that they must meet are verified through ad-hoc techniques or using difficult simulation techniques. Integration of new components in the structure of real-time system is very difficult and leads to a substantial increase in system costs. The present generations of real-time systems are distributed systems, comprising intelligent and adaptive modules to meet high dynamic performances. We mention two features of the current generation of real-time systems: the need for integration of AI skills and rapid evolution of a corresponding hardware. There is no science for real-time systems design. This does not mean that a scientific approach is not possible. Real-time calculation is equivalent to a quick calculation. The purpose of a real-time KBS is to minimize the average response time for a given set of tasks, but fulfilling individual time requirements of each task. The most important property of real-time systems is their predictability, i.e. the system's behaviour should be deterministic and meet the designing specifications. Quick calculation is a support in achieving the specifications, but alone does not guarantee the predictability of the system. Other factors contributing to the predictability are represented by a fast hardware and algorithms with good complexity. Often, the implementation language of a real-time application may not be sufficiently expressive to describe certain real-time restrictions.

An important aspect of research on real-time KBS is to investigate the effective resource allocation strategies, which can be viewed as an element of performance in real-time systems (Mazilescu 2012). A proper design of these systems involves finding solutions for other types of interesting problems, concerning the specification and verification of system's behaviour over time, as well as developing programming languages whose semantics is appropriate in relation to the time restrictions (Mazilescu 2010, Mazilescu 2011). An important problem in studying real-time KBS is the investigation of the role played by the synchronization mechanisms. Issues related to designing real time systems have been settled in areas like computer science and operational research. An important approach widely used in designing real-time KBS is the hierarchical decomposition of systems into modules. Although this methodology allows us to analyze the accuracy of calculations at each level of abstraction, it does not support an analysis concerning real-time and reliability characteristics of the whole system, which are two vital aspects of real-time systems. It is necessary to develop designing technologies for these systems, in order to incorporate the characteristics of correctness, response time and reliability at each level of abstraction, and to combine the results of each level in the integrated performances of the whole system. The fundamental problem in the specification and verification of a real time system is the method to incorporate a time metric. Common approaches to specifying the system's behaviour are based on highlighting the system's specific events and actions, and the order of their occurrence (Mazilescu 2011, Mazilescu 2012). The inclusion of a real-time metric creates problems in concurrent models' semantics and can complicate the problem of verification of the system. Verification of these systems requires fulfilling the restrictions due to implementation and environment, requiring a qualitative analysis prior to a quantitative one (Mazilescu 2010).

Planning requires a close relationship between certain processes and KBS, which must react to the events that occur. Intelligence may include the ability to accept abstract specifications of tasks in a general form of *goals / restrictions* and producing reasonable actions consistent with the specifications. In any real-time AI system there is a fundamental compromise between action and reasoning. Time is a precious resource that is consumed when the system must perform reasonings on actions before their execution. This time consuming may limit the number of alternatives of desired actions and, therefore, the reasoning task becomes more difficult. In some cases, failure of an action may be the worst solution, while in other cases any of the actions may be better than complete lack of action. The time necessary for reasoning may warn on certain delays or disasters. The efficiency of a real-time AI system depends on its ability to allocate the reasoning efforts in line with the states of the economic environment, generically called process. Allocation is often difficult due to numerous information overload. The visible state of the process is huge, and may contain incomplete, contradictory or uncertain information, which require the use of modules in KMS structure, i.e. problems solvers. In addition, this information often changes quickly. It is practically impossible for a real time system based on symbolic AI techniques to fully process all the information at a time and to choose a suitable reasoning line, respecting all the real-time restrictions. Therefore, these systems must focus their attention on some important sub-problems and allocate the available resources correspondingly. Current research in the field of real-time DAI are guided by the designing and implementation of KBSs that can be integrated in planning applications (Mazilescu 2012).

In terms of informatics, reasoning algorithm is a procedural representation of the semantics attached to knowledge. A fuzzy set defined on the field U is a function of U in the interval [0,1]. An fuzzy set L is a function defined on U with values in the ordered set L, which, in particular, can be a complete lattice. All formulas are treated similarly, leading to a complete characterization of this logics (i.e. completeness theorems). KBSS is characterized by a combination of multiple models and reasoning techniques. In addition, these systems have certain common features. The applications need different problem solving models and methods, their choice having a big impact on the KBS efficiency and analysis. Another common feature is the separation of used knowledge from how they are implemented, i.e. there is a distinction between "knowledge level" and "symbols level." These systems often combine multiple knowledge representations, problem-solving strategies and learning methods within the same system. The distinction between knowledge and representation is important, both in the design and analysis of knowledge-based systems. In designing, the distinction corresponds to the two stages of the development of such a system: acquiring a sufficient amount of knowledge to solve the problem proposed and designing a system of programs capable of processing this knowledge. Problem solving often involves different types of knowledge, about the problem's tasks (which define the problem), methods (i.e. how to solve the problem) and models (i.e. different possible behaviours of the system). This latter type of knowledge is often referred to as domain knowledge, while the first two are called control knowledge. KBS invariably incorporate all these types of knowledge, even if they are not explicitly represented (Mazilescu 2010, Qian 1992, Tesfatsion 2001).

The importance of this approach consists in demonstrating the usability of the KBS in planning and resource allocation problems, using imprecise knowledge. On the other hand, has always been tried to use formalisms and concepts specific to traditional or modern AI, with a series of KM models and techniques, especially for planning applications of business processes. From this point of view, it was necessary to continuously adapt the known models (e.g. possibility theory, discrete event systems) in order to synthesize a planning structure based on fuzzy knowledge. It has also been tried a conceptual openness to a multiagent real management structure, which is one way to fulfil a series of demands on the complexity of the planning operation. Such systems, especially those based on communication between agents by sharing memory, have features well suited for real-time applications, such as: (1) Integration of heterogeneous agents; (2) Interaction between acquisition activities, reasoning and action on the environment; (3) fusion of data coming from sources of different nature and function; (4) The flexibility and efficiency in integrating new data necessary for reasoning, simply by storing them in the common memory; (5) An agent's facility to access an information it needs; (6) The effectiveness of the reasoning control structures; (7) Focusing agent's operation on a specific action due to certain events, which take account of significant changes occurred in problem solving. Temporal aspects are an important dimension of a resource allocation KBS for KM. From this point of view there is a distinction between real-time reasoning and reasoning over time, the last aspect being a feature specific to knowledge-based systems. For this reason, it was absolutely necessary to explain the significance of time at the level of KBSS design and implementation, highlighting its implications in the case of the developed application.

STs represent a new paradigm (approach) focused on network-oriented infrastructures, automation of knowledge-based work and associated reasonings, the construction of systems that know what are doing. These technologies are tools for KMS based on ontologies, which have the ability to dynamically represent meanings, beliefs, desires, associations, theories, experience on using various entities, separately from data, information and program code. Semantic models are similar and, at the same time, different from other ICT models. The differences lie in the fact that ontologies are based on relationships built in first-order logic, are based on sets and are dynamic, organize rules using axioms, are graphs rather than trees, being used in automated reasoning procedures (Mazilescu 2009a, Mazilescu 2011, Mazilescu 2012).

Organisations are subject to a number of challenges and opportunities that cannot be successfully resolved with the current technologies. ICT markets are dominated by relational databases, algorithmic procedures, objectual programming paradigms and stack-based architectures. Installed databases are huge. A key factor for the global expansion are the telecommunications and the use of services bundles on existing structures. Processing speed or storage capacity doubles every 12 or 18 months. We are witnessing a period of explosion of infrastructures, information sources, communities of interest and knowledge that characterize global markets developed around the concept of network. Due to increasing demands and complexity of the systems, current ICT approaches are unable to bear the massive integration and interoperability between different subsystems. Infrastructure challenges include security, self-protection, scalability, web services, grid architectures, parallelism, massive distribution. Solutions in this regard must be able to solve the complexity of the systems of systems and provide the businesses with value, at costs and risks ever smaller compared to the previous ones. Automation of the work intensively based on knowledge (AWIK) and arguments is of great interest. In the field of business has been invested heavily in enterprise applications that automate transaction processing. These systems based on records allow scalability. Competitive differentiation in different industries is not related to the transactions automation and record keeping, but to ensuring the interactions with suppliers and customers or between different subsystems of the enterprise based intensively on knowledge. Current applications are too rigid, difficult to integrate and extremely expensive to replace. Current solutions must be able to link up applications, data sources and services in a user-friendly manner, close to the user, to allow real-time interaction, dynamic analysis and support for decision making. AWIK involves much more than just interoperability. The essence of this approach is founded on the calculation based on knowledge (knowledge computing). Current ICT focuses on acquiring information relating to a job, dependent on circumstances. But the knowledge necessary to achieve a job's objectives are intimately related to the employee itself (education, experience) or to learning. Experience is difficult to acquire, and when the employee leaves, the organization loses this experience plus the relational capital. New KMS approaches must include massively AWIK, but also all the reasoning theories and methods necessary for fulfilling tasks.

A major task of any manager, according to the strategic management literature and theories of knowledge-based company, is to accumulate and protect valuable knowledge. They sum up the company's ability to effectively transform its inputs into valuable outputs. Some classical theories of the firm emphasize the role of knowledge sharing against producing new knowledge and problem solving skills. A number of current theories of the firm argue strongly the importance of knowledge creation process, a process that majorly affects the organization.

The key question is not how to acquire and transfer knowledge, but how should a manager organize the employees' activity so that they generate new knowledge, the company needs to achieve its objectives. A possible scenario in this case is that a manager cannot simply acquire the necessary knowledge, since most times they do not exist. Instead, the manager must choose the real problems, i.e. those problems that, once successfully solved, produce the expected new knowledge and competencies. The value of a particular problem depends on two factors: (1) the value of each possible solution; (2) the costs of discovering a particular valuable solution. Once the problem is selected, the manager organizes the search for solutions that optimize the probability, speed and costs of finding these solutions. Continuously solving problems and discovering new knowledge or solutions (based on unique combinations of existing knowledge) are the central elements for a series of knowledge-based theories of the firm. The effective determination of new solutions can be based on some searches: (1) *local*, guided by experience or feedback, a method that becomes inefficient for indecomposable problems or if the interaction between knowledge increases; (2) *heuristic*, through the cognitive assessment of the possible consequences of alternatives.

STs have functional capabilities that allow people and computers to create, discover, represent, organize, process, manage, reason, present, distribute, use meanings and knowledge to meet certain business, personal or social goals. These technologies have a number of very important functions, such as (Mazilescu 2012): (1) Intelligent user interfaces, that allow humans and machines to understand knowledge and different interpretations associated with knowledge (uncertainty, imprecision, depending on the context, ambient intelligence, response time, the variability of truth-values relative to the production of certain events) and their efficient use. (2) The ability to recognize concepts to extract meanings from information, to classify, correlate and establish correspondence between different knowledge sources, thus facilitating interoperability. (3) The capacity to reason, to interpret, infer and justify based on explanations, using semantic models. Reasonings are based on associations, AI logics, constraints, rules, conditions, axioms which are represented in the ontology. These declarative structures allow reasonings in different directions searching for solutions and problem solving in certain state spaces. (4) Representing, organizing, integrating resources, content and knowledge. The organization of interpretations require taxonomies, distributed ontologies and knowledge bases. Since ST integrate data, content, applications and processes by means of ontology, this minimizes development and maintenance costs. (5) Self-discovering web services and functionalities. By representing semantics based on symbolic language and forms, ST can auto-generate texts, graphics, documents and natural dialogue. (6) Current development of functionalities that can *learn* (infer and create new knowledge), simulate and test, adapt certain behaviours, all this process is based on experience. Underlying the architectures of intelligent enterprise using structure models differ from traditional systems that rely on optimization, completeness and on the technique of building without model, in order to generate originality. Architectures will consist in integrating old and new components: policies based on strategic vision of the company; people, including the current culture that must change in order to adopt the new proposals of value and business processes; systems, including knowledge models that should underlie the STs, able to make reasoning. The 21st century enterprises aim to meet an ever greater demand for services, to increase revenue and productivity, to reduce costs with minimal resources. In an electronic business environment, organizations expect to obtain a high profit and reduce the activities flows through an effective collaboration between business information, partners and physical resources. To develop, businesses need new types of specialized tools, advanced services and new approaches. Based on STs can be developed intelligent enterprises, that will not only provide better services to customers, but will create business efficiency by improving relations with both suppliers and other partners.

Intelligent enterprises exist where KM and other business intelligence solutions provide the analytical capacities needed to transform data into knowledge useful for the organization. In an intelligent enterprise there are several information systems integrated with the knowledge collecting and analysis tools. These solutions enable the enterprise to improve customer service, relationships with partners and to create products based on knowledge obtained from internal data. Intelligent enterprises have expanded their horizons, being focused on their long-term reliability and success and how to satisfy all parties involved in the enterprise’s activity (shareholders, directors, management department, suppliers, employees, government etc.). Consequently, many of them have managed to create an effective enterprise, by decreasing the number of conflicts within the enterprise, through a self-energizing activity and imposing a work environment that requires minimal effort. To achieve such objectives should be maintained the extended horizons, their concerns going beyond of the customer groups, market segments and geographical regions, considering the enterprise as an open system with strong and extensive interactions with the external environment, which cannot be ignored or controlled, to adjust its objectives and strategies to pursue long-term opportunities and overcome or avoid threats. Such behaviour requires resources, infrastructure and dedicated staff. Fulfilling these conditions, the company is expected to act intelligently in any situation. The degree to which the enterprise acts intelligently depends on the competency of its employees and on the operational capabilities: structure, systems, leadership policies and forces, such as motivation. The competencies determine the efficiency of the work performed under internal and external routine occurrence and difficult challenges. Own competencies are directly (and not only) a function of knowledge - understanding, expertise and skills - available at the workplace or integrated in enterprise’s capabilities. Knowledge in the work environment are personal knowledge of individuals, integrated as structural knowledge in documents, technology, practical activities, systems, procedures, policies, organization and work structures of the enterprise. Therefore, the problem of creating the intelligent enterprise becomes the problem of managing more efficiently the knowledge. The enterprise may be intelligent in two ways. It may act intelligently or it may use intelligence (competitive information about the internal environment, objectives, competitors) to achieve its goals. To be intelligent, an enterprise must maximize the use of intellectual capital. Intelligent enterprise is an organization that currently operates efficiently and is able to address future challenges, achieving its objectives by implementing visions and strategies through the actions of the employees or through is own systems, policies and organizational structure.

Most technologies for the development of KMS already exist, but is necessary to integrate these technologies into a unified system that will generate value in certain businesses. The combination of technologies for building a KMS is difficult to be defined. The effort should be focused on two strategic areas: storage and retrieval, respectively communication. As companies and working groups operate sequentially or in parallel by one or more processes listed in the previous table, the inputs are converted into knowledge that is incorporated to create new products or services, as depicted in the figure below:

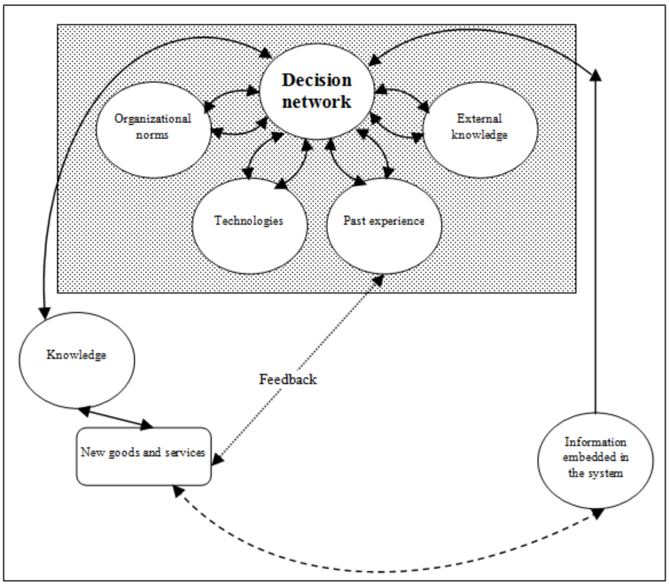

Figure 1. Incremental development cycle of a KMS

Companies increasingly structure their work around teams, where employees receive greater freedom and middle-level managers disappear as positions. Informal knowledge that exists at the middle level slowly begins to disappear. Time is probably the element that influences the most- the decisions must be precise and taken very quickly. Knowledge of what is already known can help improve these decisions. Knowledge creation and acquisition through interactions, mistakes and successes of teams: a large volume of knowledge is in the minds of employees, but rarely it is structured so as to enable the subsequent sharing and retransmissions. Organizational policies, practices and structures must be designed to remove communication barriers: (1) Between the teams: (a) among employees at the individual level; (b) between organizations. (2) Knowledge transformation: (a) For different vocabularies; (b) From tacit knowledge into explicit knowledge. (3) Identifying and removing obstacles regarding the best practices and skills transfer: (a) Within a group; (b) Among the companies from several locations; (c) Between different cultures; (d) between the companies. (4) Quick communication to the most appropriate person: support for applying, distributing and sharing solutions to problems; support for creative discussions; organizing knowledge (Indexing, Classification); Filtering, Data Mining, Aggregation, Summarizing, Making connections. (5) Knowledge Distribution: (a) Packing: Databases, mailing lists, rational captures, collaborative filtering or after a "confrontation", records in databases; (b) Sending: Networks, Web, intranets, subscription services, e-mails; (c) Storage: different media (distributed or centralized), pointers to informal knowledge, pointers to knowledge resources and expertise (people, employees' skills directories). (6) Importing and absorbing technological knowledge from outside the firm: (a) through strategic alliances; (b) through partner companies; (c) from the competition. (7) Interaction, combining and creating a meaning (largely by tools that captures the context together with the knowledge elements, and good graphical interfaces for the back-end). (8) Communities of interest and networks of people who share the same goals and interests, to create and maintain the knowledge content, improve the processes and to serve as a mechanism for the exchange and development of tacit knowledge. (9) "what-if" scenarios analysis. Technological tools necessary to achieve a KMSs are found in two distinct categories: compulsory and optional instruments.

4. Conclusions

Teams engaged in ICT projects traditionally involve two components: end-users and developers (analysts). However, for KMSs, teams must be more complex to be more effective. A KMS is built on expertise, knowledge, understanding, skills and different views brought together in the project by a variety of people who may have little in common in terms of operation. Quality of collaboration network between participants is the one that will determine the success of the system. Even if we have the plans for the best KMS in the world, this does not guarantee the successful implementation in our organization. This success comes from KMS implementation and embedding, at the cultural level, of the employees that will use it. Companies that implement a KMS can extract expertise from various sources: (1) internal centralized ICT departments; (2) local experts who work in teams; (3) external vendors, contractors, partners and consultants; (4) end users and management.

While we cannot underestimate the importance of ICT team who will actually build the system, the most important part of this team is the multitude of experts. Finding participants from a variety of functional groups inside and outside the company is essential. If the choice is correct, the system will have very high chances of success. As part of a KM team, we can identify the following categories: (1) *local expert*s: are those who arrive early and stay late at work to test all the tools that are available. They are the best persons who can identify the importance of each feature of the system. These local experts are the first to identify the limitations of the existing system and think about possible changes (e.g., marketers are constantly thinking about how technology can help them to get past sales); (2) *persons from internal ICT departments*: Local experts are limited. They do not possess technical skills besides those specific to their profession. They lack understanding of the interdependencies between complex systems, networks and technology that only ICT employees understand. While local experts will come up with ideas, ICT employees will come up with some knowledge on: infrastructure possibilities and limitations, standardization problems between different platforms, applications and tools; (3) *other experts*: they can play the role of bridge, as interpreters between people with different skills and specializations. They learn faster than an average person within the company and do not react defensively in terms of lack of understanding of other specializations than their own. *They bring value to the team unity because they are trustworthy, but are not compelled by selfish attitudes*. Such groups were often referred to as "Communities of Practice", which are characterized by: multifunctional groups incorporating different perspectives, skills, ages and roles; (4) *Consultants*: appear on stage when there are areas within the company that are not any employee’s strength. Internal participants may have small cultural differences specific to the different departments they are working, but still are linked to a common framework generated by the general culture of the organization, by the dominant values and image. External consultants often do not fit in this reference framework, is essential to exist other liaison mechanisms and personal characteristics that match well with those of internal members. This independence can be turned into an advantage, because it brings an external and balanced perspective on the general process. In such cases, trust is another important issue. By the nature of consultancy-type businesses, should not be a surprise if the external person develops exactly the same type of system for the competition after a certain time. Other features that should be taken into account when choosing a consultant include: his reputation in terms of his integrity and history, which demonstrates the ability to keep the confidentiality about past projects, if the internal team trusts him. *Such people are very hard to find*. Since KM projects are strategic, the level of confidentiality must be generally strengthened by legal contracts. *Where confidential material is involved, a better idea is to train an internal employee than to bring an external person*; (5) *managers*: their position and influence would make us believe that they should be the last to be left outside the development process. However, several studies have shown that this exclusion not only that is possible, but it happens often. One thing is clear: managers must be kept active in the KM project because, without the active involvement, the entire project may fail. Teams should be built for efficiency. There is not a general formula for creating an ideal team. Functional diversity can lead to two possible results, depending on how is handled this diversity. The first and most common result is represented by destructive conflicts and tensions. Second, the desired one, is characterized by unity, creativity and innovation.

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