KEY KNOWLEDGE MANAGEMENT TECHNOLOGIES IN THE INTELLIGENCE ENTERPRISE

RAMONA-MIHAELA MATEI
Ph.D. student, Academy of Economic Studies, Bucharest, Romania
ramona.matei1982@gmail.com

Abstract
In this rapidly changing world, the future intelligence competitions will be for rapid knowledge discovery and delivery. How to manage this knowledge has become an important issue in the past few decades, and the knowledge management (KM) community has developed a wide range of technologies and applications for both academic research and practical applications. As a part of KM research, this paper surveys and classifies KM technologies using the different categories. Some discussion is presented, indicating future development for knowledge management technologies and its applications. Also, the key enabling and emerging KM technologies that will enable future generations of intelligence enterprises are introduced in this paper.

Keywords: knowledge management, technology, intelligence enterprise, knowledge
JEL classification: D80, M10, M15, O30

Introduction
In this rapidly changing world, the future intelligence competitions will be for rapid knowledge discovery and delivery. The power of knowledge is a very important resource for preserving valuable heritage, creating core competences, learning new things, solving problems, and initiating new situations for both individual and organizations now and in the future (Shu-Hsien Liao, 2003). How to manage this knowledge has become an important issue in the past few decades, and the knowledge management (KM) community has developed a wide range of technologies and applications for both academic research and practical applications. In addition, KM has attracted much effort to explore its nature, concepts, frameworks, architectures, methodologies, tools, functions, real world implementations in terms of demonstrating KM technologies and their applications.

In such context, information technology (IT) represent the predominant influence on the progress in creating knowledge and foreknowledge within intelligence organizations. Advances in information technologies and the growth of a knowledge-based economy are transforming the basis of technological innovation and corporate competition. The critical technologies for the intelligence organization will be those that support deep and rapid analysis-synthesis. KM technologies will continue to expand human thinking, collaboration, and problem solving in the intelligence enterprise (Edward Waltz, 2003). In this paper, the key enabling and emerging KM technologies that will enable future generations of intelligence enterprises are introduced.

Purpose: To provide executives and scholars with pragmatic understanding about the key enabling and emerging KM technologies that will enable future generations of intelligence enterprises.
1. IT and KM technologies relationship in the intelligence enterprise
The intelligence enterprise encompasses the integrated entity of people, processes, and technologies that collects and analyzes intelligence data to synthesize intelligence products for decision-making consumers. (Edward Waltz, 2003). In intelligence field, technology represent the application of science by the use of engineering principles to making usage and knowledge of tools, machines, techniques, crafts, systems or methods of organization in order to solve a problem or perform a specific function. It can also refer to the collection of such tools, machinery, and procedures.

In the intelligence enterprises we can distinguish three categories of technologies that all contribute to the creating and disseminating knowledge.

**Figure 1: Categories of technologies in the intelligence enterprises**

Like figure 1 shown, KM technology is dependent upon the capabilities provided by IT and computing materials technologies and can have a significant effect on intelligence. KM technology is defined by Edward Waltz like the integration and application of cognitive and organizational sciences to implement enterprises comprised of humans and computing systems to achieve operational goals. We can find in such category collaboration messaging and knowledge exchange tools, cognitive support: data fusion, mining, analysis, and visualization tools, intelligent agents, artificial intelligence.

Huseyin Tanriverdi (2005) noted in his study that knowledge management (KM) is a critical organizational capability through which IT influences firm performance. IT relatedness enhances firm-level KM capability and KM capability improves corporate financial performance of multi business firms. In addition of that, Andrew H. Van de Ven (2005) mentioned that knowledge-intensive technologies provide sufficient proprietary benefits for sustainable competitive advantage to individual organizations and for cooperative advantage. IT can enable humans to gain experience through training, simulation, and enhanced understanding of real-life events; this way, technology can contribute to a human's growth in wisdom.

### 2. KM technology evolution

Firestone and McElroy (2002) distinguish three generations of knowledge management solutions. According to them, the first generation of knowledge management solutions (1993-1997) has been focused on information integration, establishing information repositories, information retrieval and information and knowledge sharing, while the emphasis of the second generation of knowledge management solutions is on knowledge production and its use. The third generation of knowledge management solutions that is developing nowadays is based on: use of taxonomies and ontologies for knowledge discovery in databases and on the Web; use of new data and text mining algorithms, natural language processing and other statistical tools for knowledge acquisition from different sources; distributed agent systems for searching, claim evaluation and knowledge production; knowledge portals instead of information portals, etc.
Edward Waltz (2003) noted that the sequence of integration and implementation of ITs into KM capabilities can be illustrated in the three technology generations: The first generation of KM (1985–1995) was enabled by early networked computing technologies: shared databases, email, and service directories. This generation (called a supply-side emphasis) is focused on the capture of organizational knowledge in the form of text data in relational databases and on storage of organization explicit knowledge. The second generation of KM enterprise technology emphasizes the demand-side by focusing on the delivery of products to users by multimedia, sharing culture, collaboration process, and network. Future generations of KM will emphasize the creation of knowledge by completely integrating the supply and demand sides of the enterprise with greater machine intelligence to support the human users of the enterprise. This generation will focus on integration of knowledge into all aspects of business culture and operations. These future technologies will add to the previous generations deep content understanding, intelligent support to users (autonomous intelligent agents), dynamic human-agent collaboration.

3. Key KM technologies in the intelligence enterprise
Based on the scope of 234 articles on knowledge management application, researcher Shu-Hsien Liao (2003) distinguish KM technologies using seven categories: KM framework, knowledge-based systems, data mining, information and communication technology, artificial intelligence/expert systems, database technology, and modeling, together with their applications on different research and problem domains. The technologies critical to enabling future generations of KM capabilities are divided in three categories: technologies as core (the basis of today's first and second generation KM implementations and capabilities), enabling (the technology base for the next generation), and emerging (beyond next generation, a revolutionary departure from current KM practices). (Edward Waltz, 2003). Table 1 distinguish technologies by their contribution to explicit or tacit knowledge creation or to explicit-tacit knowledge exchange.

Table 1: Key KM technologies

<table>
<thead>
<tr>
<th>KM technology</th>
<th>Enabling Technology</th>
<th>Emerging Technology</th>
</tr>
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<tbody>
<tr>
<td>Explicit Knowledge Combination Technologies</td>
<td>Multimedia content-context tagged knowledge bases</td>
<td>Automated deductive-inductive reasoning and learning</td>
</tr>
<tr>
<td></td>
<td>Multilingual natural language</td>
<td>Automated ontology creation</td>
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<tr>
<td></td>
<td>Integrated deductive-inductive reasoning</td>
<td></td>
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<tr>
<td></td>
<td>Automated deductive-inductive reasoning and learning</td>
<td></td>
</tr>
<tr>
<td>Human-Computer Tacit-Explicit Exchange Technologies</td>
<td>Collaborative agent-teams</td>
<td>Purposeful, aware agents</td>
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<td>Rapid expert knowledge acquisition</td>
<td>Human cognition augmentation</td>
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<td>Situation immersion</td>
<td>Direct brain interaction</td>
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<td></td>
<td>Natural language query and conversation</td>
<td>Pervasive personal networked computers</td>
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<td></td>
<td>Multilingual speech interaction</td>
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<tr>
<td>Knowledge-Based Organization Technologies</td>
<td>Tailored naturalistic collaboration tools</td>
<td>Human-like agent partners</td>
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<td></td>
<td>Human-agent problem-solving collaboration</td>
<td>Combined human-agent learning</td>
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<td></td>
<td>Intimate tacit simulations</td>
<td>Direct brain tacit knowledge</td>
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Source: Adapted from Edward Waltz, 2003
In this paper we intend to highlight the most important emerging KM technology capabilities that are identified on the above table.

Explicit Knowledge Combination Technologies include those that transform explicit knowledge into useable forms and those that perform combination processes to create new knowledge. Automated deductive-inductive reasoning and learning will be provided by agent-based intelligence that will coordinate inductive (learning and generalization) and deductive (decision and detection) reasoning processes across unstructured multilingual natural language, common sense, and structured knowledge bases. Agent-based intelligence will create automated ontology (knowledge bases) learning the structure of content and context under configuration management by humans.

Human-Computer Tacit-Explicit Exchange Technologies encompasses all capabilities to interface and integrate human tacit knowledge with computing machines and communication. Purposeful, aware agent technology will provide a degree of self awareness, purpose, and understanding to agents that will provide an appreciation of the overall intelligence context, enabling them to adapt, explain, and interact with analysts at a high level of abstraction. Human cognition augmentation will be provided by technologies. These technologies (instinctual systems) will detect human sense and autonomic reactions, will monitor human attention and focus and will be used to guide the flow of information and track performance to augment cognition. These will also counteract human limitations in memory, attention, learning, and sensing (visualization). Direct brain interaction represent a direct multidimensional presentation to human brain by computing to humans (multilingual speech and context recognition) and computing to physical world (robotics). Current research in this field is focused on the control of physiological functions to enable disabled individuals to control robotic devices by thought. Body-augmented networked (wireless) computations will enable continuous presence of agent-based intelligence into monitor support and anticipate human activity (pervasive personal networked computers).

Knowledge-Based Organization Technologies will increasingly integrate intelligence agents into the organization as aids, mentors, and ultimately as collaborating peers and will support the socialization processes of tacit knowledge exchange that will enhance the performance and effectiveness of organizations. Multi agent system technologies will enable the formation of agent communities of practice and teams and the creation of human-agent organizations (human-like agent partners). Personal agent tutors, mentors, and models will shadow their human partners, share experiences and observations, show what they are learning, learn monitor subtle human cues about the capture and use of tacit knowledge in collaborative analytic processes (combined human-agent learning). Direct brain biological-to-machine connections (direct brain tacit knowledge) will allow monitors to provide awareness, tracking, articulation, and capture of tacit experiences to augment human cognitive performance.

Conclusion

KM technologies are based on computing materials and ITs that enable the complex social (organizational) and cognitive processes of collaborative knowledge creation and dissemination to occur over large organizations, over massive scales of knowledge. Technologists, analysts, and developers of intelligence enterprises must monitor these fast-paced technology developments to continually reinvent the enterprise to remain competitive in the global competition for knowledge.
Intelligence organizations must to remain competitive and to leverage the significant commercial investment in information and KM technologies. Intelligence organizations must also have the vision (the wisdom to know how and what technologies to adopt, adapt, and develop) to apply these technologies while transforming the intelligence business in a rapidly changing world.

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