CONCEPTUAL KMS ARCHITECTURE WITHIN ENTERPRISE 2.0 AND CLOUD COMPUTING

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Sofia University, FMI 125, Tzarigradsko Schausse bl.2,floor 3

Abstract: Today, the adoption of Enterprise 2.0 is not an option, but a must for knowledge-based organizations within the changing social paradigms. The new-coming generation of employees and customers expect technological proficiency to be part of the customer-centered business models. On their turn, organizations need to apply new forms of cooperation with their employees, customers, suppliers and partners. The knowledge is recognized as crucial resource and its efficient management determines sustainability and survival of the businesses. Knowledge management is widely accepted management practice within companies, but knowledge management systems in fact are rarely used by knowledge workers (Davenport, 2005). Within the shift of emerging Web 2.0 and cloud computing, KMS have to be reconsidered from more social and user-focused perspective. An overview of the existing KMS architectures is made and main characteristics, advantages and limitations of the social software components are identified and assessed. At the end, a new model of user-centric architecture for distributed KMS is proposed, based on cloud computing and Enterprise 2.0 paradigm.

Key words: KMS architecture, Cloud computing, Enterprise 2.0

1. INTRODUCTION

Web 2.0 technologies and cloud computing are quickly expanding, transforming fast the Internet and information systems landscape. Many organizations need to reformulate their IT strategies, as within the framework of Enterprise 2.0 and Web 2.0 there emerge many business opportunities.

Within this new economic and technologic paradigm, the question of knowledge management (KM) and effective information systems use becomes vital for organizations. Better action-oriented exploitation of information and knowledge empower organizations to adapt faster and give them additional competitive advantage within an overcrowded global market. It is admitted that knowledge workers still lack efficient instruments to cope with increasing daily amount of information and knowledge that needs to be processed.

Nowadays knowledge management systems (KMS) represent mainly centralized predetermined repositories, organized and structured around pre-defined company functions and workflow. As pointed out by Bibikas et al., (2007), current Knowledge Management systems are not only expensive to purchase, but also necessitate the commitment of significant resources to their deployment, maintenance, and daily operation. Moreover, typical KM systems are based on predetermined workflows and rigid "information-push" approaches that reflect mainly the philosophy behind working practices in large enterprises Bibikas et al., (2007), hardly adapting to the end-users needs. As result, even customized and company-build solutions are underused, while in the same time, knowledge workers lack real IT tools supporting their daily tasks McAfee (2006). In practice, the most used and widely adopted tool by knowledge workers for managing information and knowledge still remain the e-mail (Davenport, 2005), which is overused, increasing information burden and time-consuming instrument, limiting the performance of the business relationships.

2. RESEARCH PROBLEM

Today there is a clearly recognized need for new knowledge management systems architecture, as well redefinition of its role within organizational KM processes. Web 2.0 tools and instruments are increasingly used by knowledge workers, expanding the role of knowledge production and exchange, but organizations still lack understanding how to apply Web 2.0 in a KM framework. Within this perspective there is identified a need for new effective organizational KMS, reflecting the need of organizations to extract meaningful dimension and profit from knowledge.

The present paper aims to discuss the following phenomena putting them in the context of KMS architecture.

- Emergence of Enterprise 2.0 business concepts and new focus on KM
- KMS architectures
- KMS and cloud computing model

As a result a reference model for distributed cloud KMS architecture will be proposed and discussed.

3. EMERGENCE OF ENTERPRISE 2.0 BUSINESS CONCEPTS

Following the Web 2.0 conceptualization, the Enterprise 2.0 is described by (McAfee, 2006), as emergent social software platform within companies or between companies and their partners or customers. These software platforms enable collaboration and promote community, but lack defined workflow and are indifferent to organizational identities (Buytendijk et al., 2008). Web 2.0 technologies are not equal to Enterprise 2.0 as the business function of the later is substantial.

3.1 Social factors

The emergence of Enterprise 2.0 concepts is due both on technological and on social factors requiring new forms of business relationships. These factors influence not only the use of specific technologies, but as well adoption of new business practices, leading to new business concepts, increasing company performance (Buytendijk et al., 2008).

- **Demographic change** - the Net generation is nowadays entering in the workforce and moving into management position. The new "wired" generation takes part in one pro-active and comfortable with Internet technologies population, representing an always connected customer, citizen or employee.
- **Rise of the independent workers** as part-time employees, contractors and consultants. Knowledge workers tend to be more loyal to their network of colleagues and professionals than to companies. Companies that provide an environment of collaborative learning and growth will be able to attract and retain the best and brightest individuals. Companies will have access to collaborate with large pool of experts and talents. Knowledge workers are virtual, mobile, and global.
- **New management role** - The emergence of highly mobile and independent knowledge workers will challenge the traditional management practices. Employees will work from anywhere, at any time, and on virtually any device, freely communicating and networking. So organizations will have to achieve their competitive advantage not through command, control, and operational excellence but relying on collaboration, communication, and management vision.

3.2 Enterprise 2.0 architecture

McAfee (2006) defines the SLATES framework in order to discover the Enterprise 2.0 system architecture. In the table below is presented a short overview of the Slates model, Web 2.0 technologies and KMS*:*

Table 1. SLATES Framework

SLATES	KM Function	Web2.0 Technologies	Effects on KMS
Search	Provide mechanisms for discovering information	Semantic search	Key words
Links	Provide guidance to knowledge workers in order to discover the needed knowledge and ensure emergent structure to online content	Collaborating bookmarking	Best resources are better referenced
Authoring	Enable knowledge workers to share their opinions with a broad audience	Wikis and Blogs, Podcast and Videocasts	Technologies allowing people easily to become authors
Tags	Present an alternative navigational experience exploiting unhierarchical categorization of intranet content	Tagging, Collaborating bookmarking, Wikis and Blogs	Users freely categorize content – folksonomy opposed to taxonomy
Extensions	Exploit collaborative intelligence and recommend to knowledge workers contextually relevant content	Recommender system	Automatic recommendations
Signals	Automatically alert knowledge workers for fresh available and relevant content	RSS	Automatically up-date of information

All these elements of Enterprise 2.0 are easy to use – not special skills are required, and the end users have the freedom to use them without preconceived categories or structures. On opposite, existing KMS, EIP and other organizational platforms are highly structured and does not allow users to define their own structures or practices. It is odd that unstructured

knowledge can be effectively managed by highly predefined and structured KMS.

McAfee (2006) believes that Enterprise 2.0 technologies have the potential to transform the company Intranet to what is the current Internet – a distributed online platform with constantly changing structure, built by autonomous and highly interested users. However, Internet nowadays could not be easily replaced, and knowledge workers need it. Enterprise 2.0 technologies are subject to network effects, leveraging its utility for knowledge community.

3.3 New business models

Most of the new Enterprise 2.0 business models are based on mass customization and customer self-service. The notion of "prosumer" emerges and organizations routinely outsource activities, closely collaborating with partners and customers in their efforts to innovate. The business concept of "Long tail" was defined as new source of competitive advantage for the Internet business.

A new way of achieving operational excellence is by allowing customers access to the organization's systems and processes. The advantages are that the company's costs are lowered and high-quality data is ensured. Moreover, it strengthens the company's value proposition, as customers are requesting self-service capabilities. Often customer self-service models are combined with mass customization where every transaction is tailored to the customer's specific needs.

Formerly an inside-out model in which the organization determines and performs the processes, the Enterprise 2.0 value chain is now an outside-in model in which the customer is responsible for driving the business processes so that it is relevant to them.

New business models tap this intrinsic collaborative and conversational mode of information exchange. The exchange occurs between organizations, employees, partners, and—most importantly—customers.

As a consequence, hierarchical communication of essential business information is no longer effective or efficient. Instead, existing technology should be leveraged to make relevant information available so that all who need the information can consume, modify, and replicate it. Such an organic and networked communication paradigm has important implications for how content and messaging is changing. The focus is no longer on pushing out information or opening an exclusive channel to specific groups in a linear fashion. Instead, the focus has changed to collaborating with people and systems (Buytendijk et al., 2008).

3.4 Enterprise 2.0 platform

The successful Enterprise 2.0 platform is modular in its architecture. This way, organizations are able to add the components, resources, and services that are required as the business evolves and grows. Most importantly, the platform model means that employees are not required to constantly learn new software products and business processes in order to use technology. The technology evolves processes where possible, eliminates them when they are obsolete or redundant, and makes the employee's interactions more conversational and convenient (Buytendijk et al., 2008).

4. KMS ARCHITECTURES

Knowledge management systems and architectures have been widely discussed in research and professional literature in the last decade (Alavi&Leidner, 2001, Maier, 2007, McAfee, 2006 and others). KMS as described in Alavi & Leidner (2001) are IT-based systems developed to support/enhance the process of knowledge creation, transfer, and application. KMS are defined as complex socio-technology solutions, providing opportunities for users to create knowledge assets and to share them in interacting with other agents. On the other hand –KMS are recognized to be one major enabler for KM processes within organizations.

KMS provide the basic KM infrastructure within organizations, enabling knowledge workers and organization to better access and use existing knowledge resources. Various approaches and methodologies are proposed for KMS architecture building (Woitsh, 2005, McAfee, 2006, Maier, 2007).

However, the practice shows that even well designed KMS are hardly used by knowledge workers (McAfee, 2007), thus influencing badly KM implementation and motivation. Recent survey (Davenport, 2006) discovers that knowledge workers even do not recognize KMS as part of their KM instruments. In the same time knowledge workers and organizations struggle for a system (and not focused particular tools) that could facilitate their knowledge-intensive work.

The emergence of web 2.0 technologies transformed the vision of KMS place and role. Conclusions of a recent report (APQC) summarizing the Web 2.0 technologies and KM implication, point out on the following trends: Web 2.0 enabled democratization of content and appearing of crowd intelligence, expanding collaboration, focusing on networking and limiting content storage, free use of user-driven tools depending from the content, social software tools offering more holistic approach to sharing knowledge instead of e-mails (APQC). The Web 2.0 approach is based on synergy and

cooperation, so in fact many technologies are adopted in parallel or together, complementing its interactivity and functionality for the user. An emphasis is put on the way how technologies can add new dimension for KM process for persons, for teams or for company. Thus new architectural model of KMS is expected, combining most of the Web 2.0 trends with Enterprise 2.0 vision.

4.1 KMS Architectural models

Among main KM architectural models, we can figure out 2 main KMS models, as described by Zack (1999). This classification corresponds on two main directions of KM research, human orientation and technology orientation. It points as well on the idea of differentiation of tacit and explicit knowledge.

- Interactive KMS architecture – focusing primarily on the exchange of tacit knowledge, or aiming to integrate persons and thus to facilitate knowledge sharing.
- Integrative KMS architecture – aiming to facilitate the explicit knowledge management within organization, or focusing on effective content management, indexing, tagging etc.

According to Maier (2007) the KMS architectures can be basically divided on 3 main groups:

- **Theory-driven architectures** that are result of theoretic investigations and which represent a theory-driven decomposition of an organizational knowledge base and derive ideal groups of functions or components of a corresponding ICT system respectively.
- **Vendor-specific architectures** aiming to integrate the existing IS within specific organization, placing the KM tools according to the already available ICT infrastructure. KMS is just moved in between a standard Web browser and relevant data and document sources that exist in an organization. Comprehensive KM suites comprise an often large number of modules offering functions such as text mining, tools for semantic integration of meta-data on data and documents, a search engine, visualization, administration of users and privileges, publishing and reporting.
- **Market-driven architectures** – The market-driven architectures are based on empirically proven important components of an organizational knowledge management environment which is integrated with more traditional data and document management systems as well as communication systems and other integrated company IS. These architectures are mostly presented on the base of layer models (varying

from 4 to 7 according different authors) and are the mostly exploited in practice.

Another classification proposed by Maier (2007) makes the distinction between **Centralized** KMS architecture and **Distributed** KMS architecture. Organizations emphasize mainly on centralized KMS frameworks, figuring out that they can collect and thus manage all knowledge assets and resources around one unified platform.

On opposite, distributed KMS are based on peer-2-peer collaboration. The goal of distributed KM system is to engage users in a knowledge acquisition and dissemination procedure that enables both the utilization of tacit and explicit knowledge, and often merging knowledge from different organizations in a transparent to the user process (Belsis, 2005).

Another approach for KMS architecture is the knowledge market, connecting knowledge producers and knowledge seekers (Benbya et al., 2008).

There were reviewed several innovative models for KMS architectures, combining some of the Web 2.0 tools and distribution KMS concepts (Organik- Bibikas (2008), Infotop- Maier (2007), Webblog KMS- Roll (2004), E-KMS -Woitsh (2003), Abdullah (2008) and others). However, there still lack integration of overall KMS functions and Internet, combining application of Enterprise 2.0 and cloud computing business model. The new proposed framework for distributed KMS will aim to deliver better instrument for knowledge workers to create their virtual working place, integrating better internal and external organizational resources.

4.2 KMS architecture and Cloud computing model

Cloud computing is one of the major consequences of Web 2.0 in the software development, discovering new business models and extending the philosophy of IS use. There emerged the following concepts, allowing reformulation of company information systems position:

- Software as a service (SaaS): Software deployed as a hosted service and accessed over the Internet.
- Platform as a service (PaaS): Platforms that can be used to deploy applications provided by customers or partners of the PaaS provider.
- Infrastructure as a service (IaaS): Computing infrastructure, such as servers, storage, and network, delivered as a cloud service, typically through virtualization

The benefits of cloud computing are widely discussed in practice, focusing on increased agility, adaptability, flexibility, cost savings and interoperability Kim (2009). However, cloud computing today faces some security, privacy, and other barriers that prevent their widespread enterprise

adoption Li (2009). This is the reason for appearance of external and internal clouds.

The services that cloud computing include may be broken down into 4 *components (adapted by Kim, 2009):*

Table 2.Cloud computing elements

Managed services	A managed service is aimed at delivering an application to an enterprise, rather than to end customers directly.
Software as a Service (SaaS)	The SaaS vendors run a single application in a data center, and deliver the functionality via the Internet to the users.
Web services	Web service providers offer APIs that application developers can use in developing applications.
Infrastructure as a service (IaaS), Utility computing	Many players have recently started to offer computing resources, as virtual servers and storage as utility computing service.
Platform as a service (PaaS)	PaaS delivers an application development environment (platform) as a service, typically with computing resources for hosting the applications developed on the platform.

Knowledge in the cloud is a new concept formulated in (Cerri D et al., 2008), extending the idea of “data in the cloud”. To take advantage of a "knowledge in the cloud” vision, firstly semantic knowledge must be extracted from the underlying data. This knowledge is shared in the overlying knowledge cloud (which provides ubiquitous access) in active (i.e. with reasoning) spaces (which provide collaboration and coordination). The Knowledge in the cloud extends the enterprise infrastructure, as cloud computing (placing data in the cloud), collaboration (wikis, blogs) and knowledge management fundamentally extend the organizational boundaries.

Development of KMS architecture model using the cloud computing approach can be the next step toward more effective and user-oriented distributed KMS solution. The 3 perspectives of Cloud computing (Fig.1) – SaaS, IaaS and PaaS will allow organizations to develop new models of KMS integrating additional systems, collaborating with other organizations and facilitating the knowledge exchange. The adoption of the cloud computing approach will facilitate knowledge sharing and integration of various platforms and IT services around two main clouds - internal and external. According to Li (2009) there is a clear trend for expansion of external clouds in the near future as the cloud computing model improves over time and security technologies improve. Another benefit is that cloud

computing will allow knowledge workers to integrate freely content from external and internal clouds, using Web 2.0 tools (as Mashups, Wiki, Blogs etc), and creating their own virtual working place. This virtual working place could combine as well several clouds of various organizations, facilitating knowledge transfer.

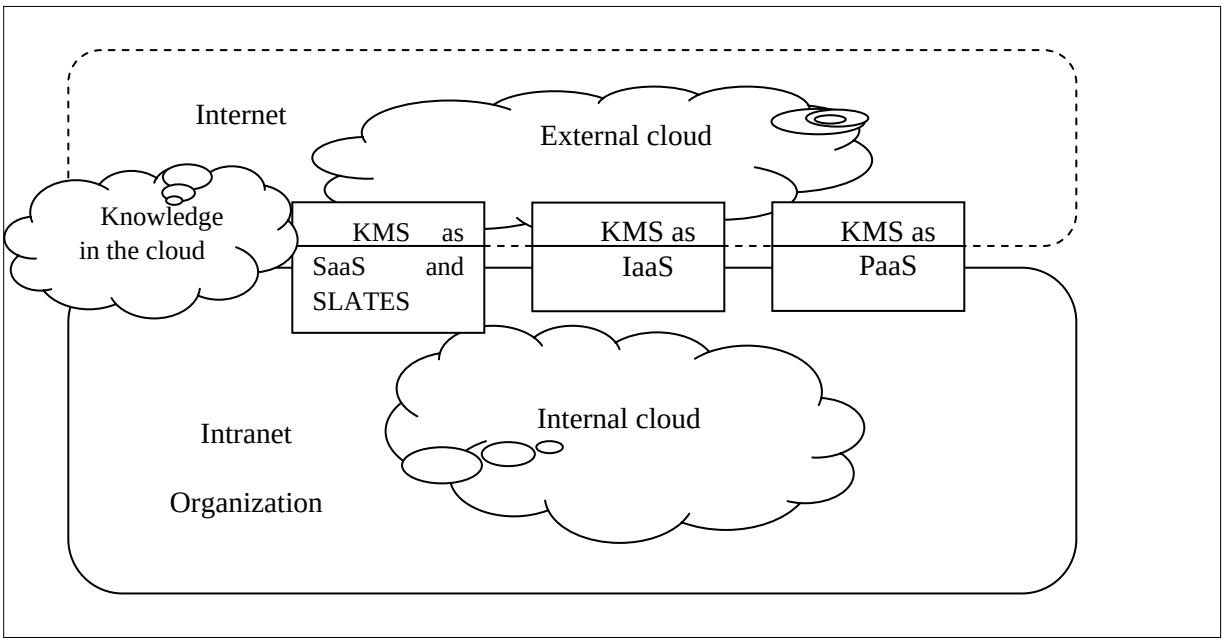

Figure 1. Cloud computing and distributed KMS

The Cloud computing model allows companies to adopt the SLATES platform and to benefit from emerging web 2.0 business perspectives. Integration of KMS within a cloud oriented technological infrastructure could enhance knowledge workers with user-centered technologies, but as well could facilitate organizations to better assume and manage their knowledge assets. An important issue to be further researched is the way the security, privacy and IPR protection could be successfully applied.

5. CONCLUSIONS

The benefits and the obvious superiority of distributed Knowledge Management systems have attracted considerable interest (Belsis, 2005). A large number of distributed KM systems have emerged, other focusing on the expansion of knowledge sharing capabilities, other emphasizing on authentication schemes. It is admitted that Social Software Tools and web

2.0 had revolutionized the way ICT can support knowledge management processes because of the ease of its use and implementation.

McAfee (2006) claims that there are two potential threats for Enterprise 2.0 implementation. The first is that busy knowledge workers will not adopt Enterprise 2.0 technologies. As he admits the majority of Internet users still are not the bloggers, the wikipedians or the taggers. The second threat is the management attitude toward distributed KMS business models, or the how company managers will accept hardly-controllable content to appear online.

There are many factors that will influence the development of next KMS architectures. Knowledge management is one important aspect for future business models and thus the research in the area will try further to figure out the best match between technological and social paradigms.

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