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Effective Knowledge Management Infrastructure Using Knowledge Grid

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Abstract
Knowledge Grid is an intelligent and sustainable Internet application environment that enables people or virtual roles to effectively capture, publish, share and manage explicit knowledge resources. Knowledge Management(KM) in e-learning based on knowledge grid makes easily use of the grid technology and integrates the methods and tools of KM in e-learning to support the whole cycle of knowledge application in enterprise. Based on the advantages of KM in e-learning, in this paper, we propose a service-oriented model of KM in e-learning environment in order to achieve more effective knowledge sharing and knowledge service. Our Proposed infrastructure is a comprehensive and effective enterprise knowledge-based framework aimed for the analysis of knowledge management and development of an enterprise knowledge in e-learning systems and integrate them with the Knowledge Grid(KG) technology. This approach concerning the modelling of enterprise domains and aspects that are essential for the development of the concept of enterprise knowledge management based on knowledge grid. First, an enterprise infrastructure is suggested for the phases of enterprise knowledge management by a system framework. That model is then enhanced with the concepts of KG technology from e-learning viewpoint by considering architectural view. A discussion on and how in our proposed framework enterprise knowledge management and e-learning can be integrated and leveraged for effective online education and training is then presented.

Key words: Knowledge Base, Knowledge Grid, Knowledge Management, Knowledge Repository

1. Introduction
Knowledge management (KM) initiatives in enterprises are most often driven by strategic planners with the objectives to enhance knowledge processing and organizational learning capacity, protect and develop the intellectual capital, be innovative and competitive on the knowledge discovery services. Lenat, D. (1995) emphasizes that Knowledge grid achieves information processing and knowledge acquisition by the technology of Semantic Web; uses the layered architecture to build a resource and information sharing platform providing a

higher level of integration and shared services; and its essence is the collaboration and sharing of the knowledge resources and knowledge service in e-learning environment.

This paper investigates the integration of E-learning and enterprise Knowledge Management with Knowledge Grid to improve the capture, organization and delivery of training courses and large amounts of corporate enterprise knowledge and propose the Knowledge Grid-based Enterprise framework aimed for the analysis of knowledge management and development of an Enterprise knowledge in e-learning environment and integrate them with different information technology strategies. First, an enterprise infrastructure is suggested for the phases of enterprise knowledge management by a system framework. That model is then enhanced with concepts of KG technology from e-learning viewpoint by considering architectural view. A discussion on and how in our proposed framework enterprise knowledge management and e-learning can be integrated and leveraged for effective online education and training is then presented. Briefly, our proposed KG based enterprise knowledge management framework, supports the following:

- Access to both internal and external information resources and different type of enterprise knowledge through our proposed knowledge management infrastructure in enterprise by using KG and parallel knowledge discovery;
- Processes and tool support to acquire, refine, store, retrieve, disseminate and present enterprise knowledge and distributed repositories that contain explicit knowledge;
- Intelligent aggregation and integration of knowledge and Organizational structures and architectural view to enable and foster a enterprise knowledge sharing in e-learning organization and integrate it with KG;

2.Suggested Infrastructure

The investigations in the enterprise knowledge management area are closely related to modeling frameworks in the area of enterprise architecture (EA) based on KG, enterprise modeling frameworks and languages.

Knowledge grid (KG) is the convergence of a comprehensive computational infrastructure along with the scientific data collections and applications for routinely supporting the synthesis of knowledge from that data . Zhuge, H. (2004) express that the Knowledge Grid is an intelligent and sustainable Internet application environment that enables people or virtual roles (mechanisms that facilitate interoperation among users, applications, and resources) to effectively capture, publish, share and manage explicit knowledge resources. It also provides on-demand services to support innovation, cooperative teamwork, problem-solving and decision making. It incorporates epistemology and ontology to reflect human cognition characteristics; exploits social, ecological andeconomic principles; and adopts the techniques and standards developed during work toward the next-generation web.

Our proposed framework is aimed to support the effective integration of Knowledge Grid (KG) and enterprise knowledge management and develop it into a e-learning process by advocating alignment between and within major enterprise views, namely, e-learning process and infrastructure, and KG infrastructure. Analysis of the Enterprise modelling (EM) methods and Enterprise architecture (EA) frameworks is the basis for presented findings. So, we can consider the 3 basic aspects of the enterprise knowledge in the contemporary EM and EA approaches: knowledge concerning enterprise knowledge management strategy; knowledge

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concerning e-learning process management and controls; knowledge related to usage of KG technology .

In order to sum up the above overview of enterprise modelling domains and aspects and integrate Rosemary, H. (2002), Allee, V. (2000) viewpoints about knowledge space, we make a premise that there are 3 integrated aspects of the enterprise knowledge: knowledge about e-learning process (EL), Knowledge based on Grid technology (KG) and knowledge about enterprise knowledge management methods and systems(EKM). The composition of three dimension Enterprise Knowledge Component (EL, KG, EKM) represents a new viewpoint to enterprise knowledge modeling that can obviate many current defects and structural weaknesses.

Enterprise management facilities (decision making units) need complex integrated knowledge about Enterprise domains. In our approach Enterprise knowledge component (EL, KG, EKM) is a composition of 3 obligatory parts: enterprise knowledge management methods (EKM) that are necessary for KG-based enterprise e-learning process (EL) management and integration. Roure, D. (2005) et al emphasizes that The e-learning process dimension stands for the ability of an e-cooperation system to construct effective learning mechanisms and learning processes that support the achievement of different educational goals. With no doubt this dimension incorporates issues like learning styles, learning needs, learning templates as well as learning specification settings .

The KG dimension in Zhuge, H. (2005) is considered for the e-cooperation platforms the capacity of collaboration with other applications in order to obtain learning content from real network operations that are based on KG technology and relevant network architecture that with respect we accept it. totally The education knowledge service is used to support knowledge sharing in the field of education based on the function of traditional knowledge service, and it is a kind of service and technology applied to knowledge management. It makes full use of the semantic and ontology of knowledge, and analyzes the semantic of knowledge to build the semantic knowledge services, semantic data integration, resource agent, workflow package in order to achieve sufficient and efficiency use for education knowledge. The education knowledge service is mainly used to solve six challenges in knowledge life cycle: the acquisition, modeling, retrieval, reuse, publishing and management for education knowledge. Integrating these six aspects will build a flexible, scalable and easy to reused framework of education services.

The enterprise knowledge management method dimension that proposed by Gudas, S. (2008) summarises the ability of the e-learning platform to manage learning content in various formats, to reuse learning modules and to support enterprise knowledge management processes such as knowledge creation, knowledge codification, knowledge transformation and knowledge diffusion. This Enterprise knowledge component specifies the required piece of knowledge retrieved by the Enterprise Knowledge management system responding to the query of some decision-making unit (department) located at the operational management level.

One way of understanding the impact of enterprise knowledge management on a corporation or government organization is to look at the knowledge enterprise management lifecycle and the flow of enterprise knowledge in the organization. Nonaka, I., & Takeuchi, H. (1995) have investigated the relationship between tacit knowledge and explicit knowledge and have

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described four phases of knowledge conversion: Socialization, Externalization, Combination and Internalization. The goal of the implementation of knowledge management in an organization is to increase the amount of tacit knowledge that an individual has available to apply to solving business problems. In order to complete their suggests for enterprise modeling of knowledge in e-learning systems we emphasize that we can consider and add fifth and six phases: Cognition, Feedback which refine the application and flow of enterprise knowledge that has been exchanged through the other phases. So, we can consider an enterprise knowledge conversion phases in e-learning systems as follow:

- Socialization: Competency and skills measurements help identify the best distributed resources include specific knowledge in the organization based on e-learning requirements for knowledge acquisition.

- Externalization: Enterprise knowledge deduction which is captured by the system with the intent of teaching that enterprise knowledge to a knowledge seeker or learner in e-learning system. This improves the enterprise knowledge capture process.

- Combination: Enterprise knowledge about learning process that is organized to make learning the enterprise knowledge more effective and efficient. Pedagogical techniques are embedded in the enterprise knowledge.

- Internalization: Competency and skills measurements that help identify the enterprise knowledge efficiency in practice. E-learning will insure that a person has learned the enterprise knowledge using assessments and alternative learning methods, if necessary.

- Cognition: on demand performance support by getting just the training materials that the knowledge seeker need at the time to complete learning peocess.

- Feedback: Assessments provide feedback concerning how well a knowledge seeker has learned and how well they have applied what they learned to a problem.

In our suggested framework, a Knowledge Holder can transfer tacit knowledge to a Knowledge Seeker through socialization or create explicit knowledge and store it in a knowledge repository and other databases. Berman, F. (2001) determines that the Knowledge Organizer can be a role who relates the created enterprise knowledge to other knowledge in the repository or further refines the created knowledge. The Instructional Designer that proposed in Gudas, S. (2008) is a person who organizes the learning of the knowledge by adding pre-assessments, additional learning aids, and post-assessments. The learner then learns the explicit knowledge through an online guided learning experience. The Knowledge Seeker then uses the knowledge gained through socialization or internalization to make decisions and perform tasks in the enterprise space. The performance of the Knowledge Seeker on these decisions and tasks is measured and returned to the knowledge repository as feedback that can be used to help determine if the skills have been learned and to suggest additional e-learning experiences. The enterprise knowledge space E (EKM, KG, EL) is developed for the systematization of the enterprise knowledge modelling area; it is aimed to be employed for the development of practical enterprise knowledge modelling and management methods. Each item e in the Enterprise Knowledge Space E (EKM, KG, EL) is identified along 3 axes:

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$$e(EKM, KG, EL) \in E, \forall\ EKM, KG, EL \in \{1,...,6\}.$$

Each of 6 items within the Enterprise Knowledge Space has its own semantics in relation with each of enterprise knowledge management lifecycle steps and identifies the definite component of enterprise knowledge, which integrates 3 aspects of the enterprise: knowledge about e-learning process (EL), KG technology preferences (KG) and knowledge about enterprise knowledge management methods (EKM) at the same level of elaboration in one of the enterprise knowledge management lifecycle steps and play a essential role in our suggested framework.

3. Enterprise Knowledge Management System Architecture

The system model consist of five tiered architecture; Data Access Layer, Enterprise Knowledge Base Layer, E-learning Process Layer, Knowledge Representation Layer, Information Technology Strategy Layer. The system architecture is shown in Fig1:
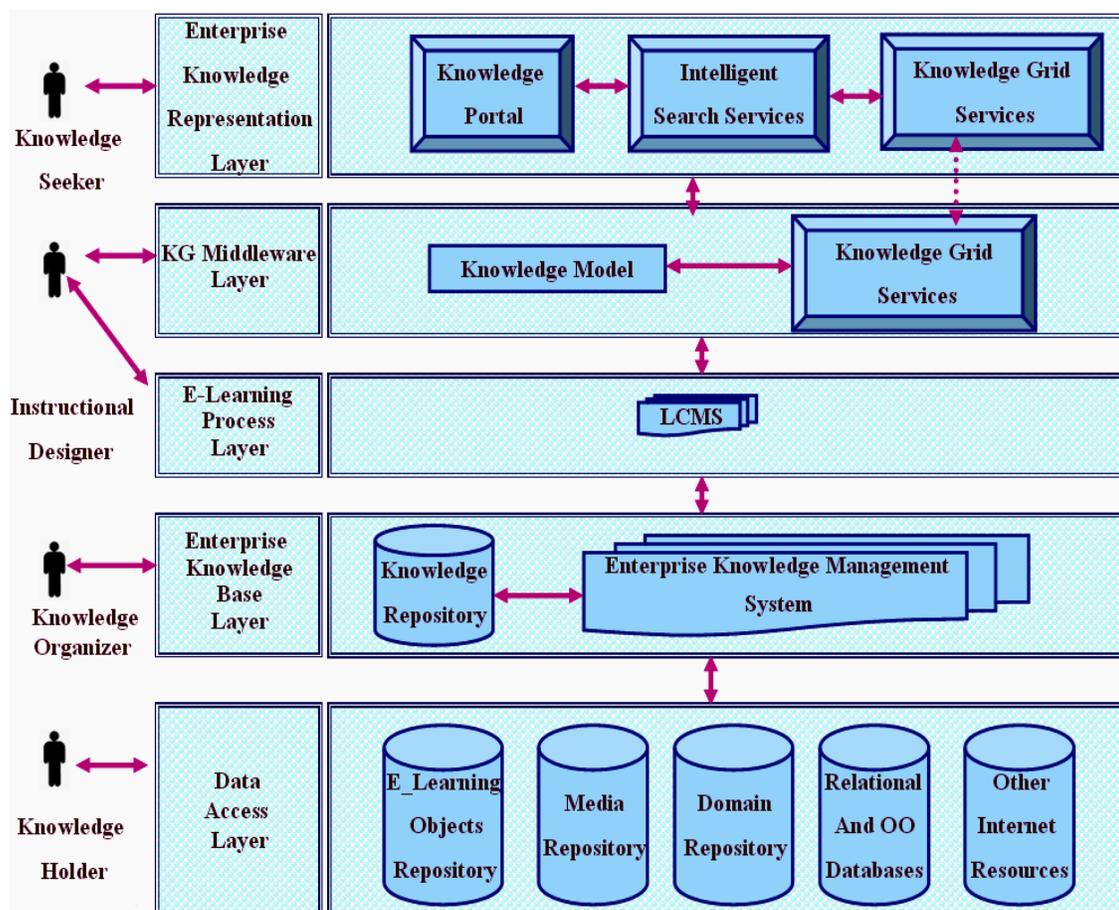

Fig 1: Enterprise Knowledge Management System Architecture

These layers will be described in detail as follow:

- **Data Access Layer**

This layer includes several distributed databases and repositories like Learning Objects Repository, Media Repository, Domain Repository, Relational And OO Databases that

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simplifies restoring, accessing and retriving enterprise components and objects that we need to knowledge deduction. Learning objects are created and stored in a E-learning Object Repository so that they can be reused in other courses. This helps to quick to knowledge deduction when new courses are created for existing products.

In this layer, The useful information and knowledge models are extracted from knowledge resources placed in different repositories and databases by the technology of knowledge acquisition. we use Dublin core-based metadata standards to describe the characteristics of resources which mainly contain the common properties of resources, education properties, technical attributes, as well as the evaluating information of resources. The metadata standards are used to describe the characteristics of resources, which can solve the problem of interoperability and reuse, help the computer understand the contents of resources in some degree, and lay the foundation for realizing the personalized knowledge push services. process of knowledge acquisition based on Knowledge Grid services, the natural language needs to be tagged and described in semantic, and then ontology rules of domain knowledge are structured.

- **Enterprise Knowledge Base Layer**

The main three tasks that is supported by this layer are: enterprise knowledge creation, enterprise knowledge sharing and enterprise knowledge reuse. The extracted enterprise knowledge can be used to enhance the Knowledge Repository and to provide refined knowledge to decisionmakers. This layer includes two basic components: Knowledge Repository, Enterprise Knowledge Management System(EKMS).

Also, EKMS includes some essential other services like knowledge conversion service that is mainly in charge of the semantic description of a distributed resources and resource coordination service that supervises the use of the resources and responses the request for the workflow that Gudas, S., & Brundzaite, R. (2007) used in their approaches for knowledge management.

- **E-learning process Layer**

Each learning processes combines a number of learning objects and specific functionalities that permit enterprise knowledge exploitation for special learning purposes. Each process has associated activities and technological components. A learning template specifies the way that each user will interact to the specific learning process. The model emphasizes the role of enterprise knowledge management for different learning processes so the realization of organizational infrastructure requires extensive technological considerations and development efforts. The suggested approach uses a Learning Content Management System(LCMS) as a system that enables the creation, storage, management, and deployment of learning content to serve the needs of individual learners.

- **Knowledge Grid Middleware Layer**

Knowledge grid services is the main component in the Knowledge Grid Middleware Layer and it includes: visualization service, reasoning service, personalized push service, and evaluation service that we introduce these important services in detail:

(1) Visualization service. Based on the association rule, cluster model or class, the system builds a knowledge model, and then uses charts, images or other visual elements to display the non-spatial knowledge expressed in the knowledge model. Doing that can help people to understand the relationships between all kinds of knowledge and trends of development, and deepen the understanding on knowledge.

(2) Reasoning service. It provides users with personalized knowledge reasoning services. The system founds and excavates the knowledge matching with user's request by way of identifying, selecting, downloading data mining tools, algorithms and rules, and then responses to user's demand through knowledge positioning and knowledge pushing.

(3) Personalized push service. Based on personality characteristics of users', the push service for education knowledge provides personalized and proactive information services. That is to say based on user's personalized needs (including categories, subjects, keywords and the combinational conditions, etc.) and the different rules for push, the system sends different messages for different users. In this framework, we use agent technology to push personalized knowledge for users based on the search conditions users setting. The agent will automatically search the knowledge meeting the requirements of users, and regularly or irregularly transmit the education knowledge on the Internet to users computer by way of Push or Web-casting providing scheduled track services in order to achieve the automatic and intelligent push for education knowledge. Some of the above services used in Iyer, B., & Gottlieb, R. (2004) but not in enterprise dimension.

- **Enterprise Knowledge Representation Layer**

The services provided at this layer enable knowledge seekers to obtain personalized information via Knowledge Portals or perform specialized search for information through Search Services in this layer, to collaborate in the creation of new knowledge, and to transform tacit knowledge into explicit knowledge via discussion groups.

4. Conclusions

In this paper we proposed a grid-based and service-oriented model of enterprise knowledge management in e-learning environment in order to achieve more effective knowledge sharing and knowledge services. Grid-based and service-oriented knowledge management in education can realize the smart aggregation to the education knowledge distributed in all over the world and better management of knowledge, provide knowledge services for learners by a single semantic entrance, and in the end make knowledge-sharing in education and knowledge innovation a reality. Suggested infrastructure also provide a roadmap for the evolution of new systems that will provide both the efficient capture of enterprise knowledge and the efficient delivery of enterprise knowledge.

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