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Toward Knowledge Management as a Service in Cloud-Based Environments

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Abstract

As new technologies and paradigms emerge, businesses have to make new efforts to properly get aligned with them, especially in knowledge management area. Today the Cloud Computing paradigm is becoming more and more popular, due to the vast decrease in time, cost and effort for meeting software development needs. It also provides a great means for gathering and redistributing knowledge. Therefore, it has a great capability for providing knowledge management services that can be used extensively for business intelligence and competitive intelligence. Currently these capabilities are not utilized for knowledge management in intra- and inter-organization businesses. In this paper, we introduced the architecture of KMaaS and its detailed services and their relationships and dependencies. We also analyze how different cloud deployment/service models can be used for knowledge management in the cloud environment and the application scenarios are provided as well.

Keywords: Knowledge Management as a Service, Cloud Computing, Knowledge Management, Service Oriented Architecture, Competitive Intelligence, Business Intelligence.

1. Introduction

The concept of Knowledge Management emerged in 1960s [1] , and has gone through various stages of conforming and adapting with different business- and technology-oriented issues. Day after day, the importance of knowledge management becomes more clear, and the need to quality Knowledge Management Systems (KMS) that comply with

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the modern technologies and business, increases. There are many different definitions for knowledge and knowledge management systems. Based on [2] the definition of knowledge can be seen from four viewpoints: (1) personal perception, (2) output acquired from information, (3) organizational resources and (4) combination of personal perception and output of information. Knowledge management is a process comprised of creating, organizing, sharing and using tacit and explicit knowledge [3] .

In this regard, knowledge management systems are IT-based systems that are developed to support the Knowledge management process [4] . Knowledge does not reside merely inside an enterprise, but, maybe a great amount of knowledge is acquired from outside the enterprise boundaries, most importantly from (but not limited to) partners, competitors, market, and customers. The role of knowledge management is so important that it is known as the basis for most of the decisions made at different levels providing intelligence for an enterprise, and based on [5] it is the basis for business intelligence, competitive intelligence and strategic intelligence. No need to mention that it is a very crucial means for market intelligence as well, as it can provide the most useful market knowledge. Knowledge management, however, is not a static process, staying in almost a constant state; on the contrary, it is dynamic from two dimensions: the business and the technology.

Thus, for the success of knowledge management, it should be kept aligned with the business and the technology, which is fast upgrading. One of the new popular technological paradigms is cloud computing (CC) that is an extension to grid computing and the service-oriented architecture (SOA). Cloud Computing is a model for enabling convenient, on-demand access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [6] Cloud computing realizes the idea of "everything as a Service" (XaaS).

As [6] articulates, CC has five key characteristics: (1) providing on demand self-service, (2) based on broad network access, (3) making advantage of resource pooling, (4) rapid elasticity based on cloud consumers' resource needs and (5) providing the ability to

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measure the provided services. Three main service models are defined in cloud computing: (1) SaaS: Software as a Service, (2) PaaS: Platform as a Service, and (3) IaaS: Infrastructure as a Service, however, other issues can, as well, replace "X" in "XaaS". Figure 1 depicts the main cloud computing service models as well as four main deployment models. These deployment models provide four types of clouds namely private clouds (limited to one enterprise), public clouds (unlimited), community clouds (shared between definite enterprises) and hybrid clouds (mixture of any two or three cloud types mentioned above). As it is clear, cloud computing provides infrastructures for realizing new virtual cloud-based business models in the cyber space, making a basis for cloud ecosystems.

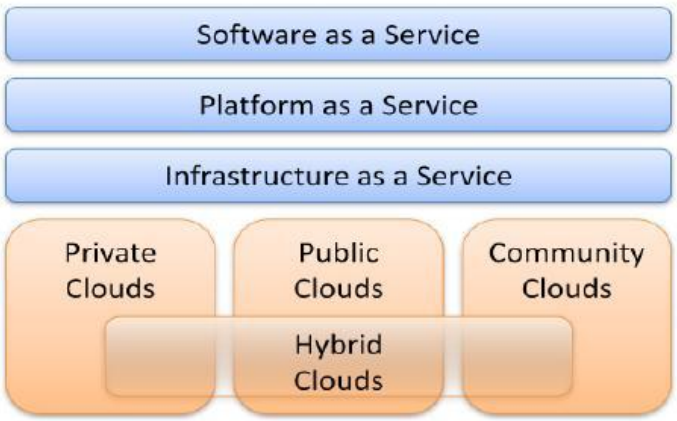

Fig. 1. Cloud Computing main Service models and deployment models [7]

With the advent of the new technological paradigms such as SOA and cloud computing on one hand, and the emergence of social networks which are, to a great extent, compliant with them, on the other hand, we have a great means for acquiring, sharing and using knowledge (especially tacit knowledge), and thereby, realizing a great advance in knowledge management area. Current knowledge management systems aim at centralizing the knowledge assets [8] often representing centralized standalone information solution [9] aiming to extract some neutral knowledge from employees to

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verify, transform, and store. These KMS solutions are not only expensive to purchase but also necessitate the commitment of significant resources to their deployment, maintenance and daily operation [10] . Tacit knowledge is also another important issue that is neglected often, since they cannot be represented as formally as explicit knowledge can. As [11] states, in reality, the most widely used tool for knowledge sharing is still the email, however, we believe a basic structure can be very useful for future transformations and usage. One of the most important types of tacit knowledge can be "experiences", "lessons learned", etc. that can easily be acquired through a social network on a cloud environment basis via well-designed knowledge-specific services.

In this paper, we aim at providing a cloud based architecture for knowledge management, namely "Knowledge Management as a Service" or KMaaS for short; we introduce KMaaS services in detail, as well as the dependencies and relationships between them. We also provide several application scenarios for KMaaS. The rest of the paper is organized as follows: In section two, the related work is provided. In section three, after providing some basic concepts, KMaaS is discussed in detail including the overall architecture, introduction to the services that comprise KMaaS, as well as their dependencies. Moreover the application of cloud computing models in knowledge management is discussed and analyzed. In section 4, several KMaaS application scenarios are discussed and in the end, conclusion and future work is provided.

2. Related work

Conventionally, knowledge management systems architectural models fall in one of the main two categories: interactive and integrative. The former mainly focuses on tacit knowledge, while the latter focuses on explicit knowledge management [12] . Moreover, [8] divides the KMS architectural models into three divisions. *Theory-driven* architectures represent a theory-driven decomposition of the organizational knowledge base and derive ideal corresponding IT components. *Vendor-specific* architectures focus on the integration of existing IT systems with the suitable knowledge management tools. *Market-driven* architectures are based on practical main components of an organization's

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knowledge management focusing on integration of these components with the IT infrastructures and existing applications. In another categorization [13] , KMS architectural models are either centralized or distributed, the former being technology-oriented while the latter is human-oriented and based on peer-to-peer collaboration aiming at getting users involved in knowledge acquisition and sharing [14] .

In classic centralized KMSs, the KMS could mainly have two components: knowledge repository and knowledge map [15] . Knowledge acquisition is an activity that is mainly done by human users and the role of IT is limited to the storage and retrieval. The role of broadband networks in knowledge management appears in introducing the notion of distributed architectures for knowledge management systems, letting users look for knowledge outside the organization, letting inter-organizational acquisition and sharing of knowledge. There is a survey of several examples of distributed knowledge management architectural models in [16] , however, none of them can yet make the most advantage of the whole infrastructure, mainly the internet and the resources that reside on it.

Cloud computing is another paradigm that should be taken into account, since it highly affects the way businesses and people on a broadband network infrastructure are connected and collaborating. The emergence of the Web 2.0 and social networks provide a great opportunity for knowledge acquisition, sharing, learning, and eventually leading to enterprise intelligence. There are very few researches carried out in cloud-based knowledge management, most of which, only take a general look to the issue, providing a very general sketch of what the KMS architecture should be like. In [17] , Enterprise Knowledge Cloud (EKC) is introduced. It is a "collaborative, cooperative, competing mega-structure, providing computing, networking and storage services to various knowledge producers and consumers being devices, people and applications".

The paper proposes a good insight to cloud computing and its benefits to knowledge management and it provides a high-level architectural model, however, little detail is provided. [16] provides the position of distributed KMS within the cloud computing environment, discussing the opportunities provided by an extended KMS architecture that combines the elements of web 2.0 technologies. In [18] the main characteristics,

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advantages and limitations of the social software components are identified and discussed and in addition, a model of user-centric architecture is provided for distributed KMS which is based on cloud computing and enterprise 2.0 paradigm. The architecture explores KMS as a SaaS, as a PaaS and as an IaaS. However, in none of the three papers mentioned above, enough details of the architecture are depicted and discussed, which leads to a "too general" model. The elements of these architectural models are not identified. Additionally in a cloud environment the aim is to provide "everything as a service", including knowledge as a service (KaaS) and knowledge management as a service (KMaaS). Only one IT-based paper in this regard is available that introduces the initial notion of KaaS and focuses mainly on the possible security issues such as knowledge leak as well as a type of attack to such knowledge management systems namely knowledge breaching. Although the paper is very well introducing the notion, it does not discuss the architectural model and its services in detail.

3. KMaaS: Knowledge Management as a Service

Technology is one of the most important factors that knowledge management should be kept aligned with, in order to keep itself powerful and useful. Cloud computing is the paradigm that can benefit KM from two aspects: keeping it aligned to the new technological progresses, and providing a great means that can highly benefit knowledge sharing and acquisition in a highly distributed and dynamic environment. Different cloud deployment models allows for a determined type of controlled relationships between clouds, since it provides ways for intercommunications between public, private, community and hybrid clouds. In such a space, modern cloud based virtual businesses can form, which, are both in need of knowledge and can provide and share great amounts of valuable knowledge. Virtual organizations are highly in need of controlled knowledge sharing among them.

On the other hand the competitive aspects (the need to competitive intelligence) also requires the relationship between the virtual parties to collect, share and provide knowledge among them. As we discussed in section 2, currently there are no fully

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described architectural models for this purpose. In this section, first, be provide some of the main key concepts, discuss the ways cloud computing models can be used in knowledge management area, and then introduce KMaaS in detail including its comprising services and their relationships.

3.1. Key Concepts

3.1.1. Cloud computing

Cloud Computing is “a model for enabling convenient, on-demand access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”[6] . Foster [19] defines the notions as "a large-scale distributed computing paradigm that is driven by economies of scale, in which a pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services are delivered on demand to external customers over the Internet". Cloud computing is computation, software, data access, and storage services that do not require the end-users to know the physical location and configuration of the system that delivers the services. It is a natural evolution of the widespread adoption of virtualization, service-oriented architecture, and utility computing.

It typically involves provisioning of dynamically scalable and often virtualized resources. It is a consequence of the ease-of-access to remote computing sites provided by the Internet. This frequently includes web-based applications that users can access and use through a web browser as if it is a program installed locally on their own computer. How a cloud is requested, selected and provided is shown in figure 2. A vendor (cloud provider) registers its cloud in some repository. This includes the cloud's SLAs (service level agreements) which will serve as a main resource for the customer to choose among different options.

For this purpose, the customer (person or even another cloud) sends a request to the registry (a query) to find the most proper cloud. [20] provides a method to use SQL for querying the repository and suggests "cloud mining" for this purpose. The repository will

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provide information about the cloud, its type and other properties like the SLA, interface, which shows how the customer should use the cloud, as well as the payment method. Based on the result of evaluation that is conducted by the customer, the customer may subscribe to the cloud and use it, or reject the option, and in the former case, the payment will be done.

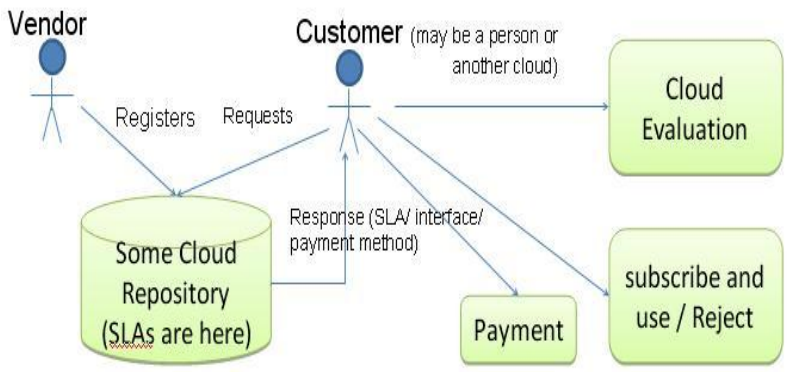

Fig. 2. cloud selection process by cloud customer, and cloud provision process by cloud provider

3.1.2. Cloud Service Models and Knowledge Management

IaaS

Cloud infrastructure services, or "*Infrastructure as a Service (IaaS)*", is typically a platform virtualization environment that delivers computer infrastructure as a service. That is, instead of purchasing servers, software, data-center space or network equipment, it is possible for the clients to buy these resources in a fully outsourced way. Infrastructure suppliers typically bill such services on the basis of the amount of resources consumed.

Knowledge management in the cloud requires using the infrastructure for storing knowledge in great sizes and for learning and inference requirements for computational capacity. Activities like publishing a problem to a potential group of problem-solvers is

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an example that shows the need to interconnection and processing power in the infrastructure layer.

PaaS

Cloud platform services, also known as "*Platform as a Service (PaaS)*", deliver a computing platform as a service, that often consumes *IaaS services*, and Software as a Service (SaaS) applications can be run on them, to facilitate the deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers.

Knowledge management in the cloud may use the PaaS services to allow knowledge workers (with technological expertise) to design their own applications on the basis of the provided platforms. These applications can become very widespread among a variety of users, making it possible to solve problems online, getting valuable knowledge from different sources based on knowledge workers' creativity in expressing their needs and sharing the problem via the desired cloud applications online.

SaaS

Software as a service (SaaS), also known as "software on demand," is software that is deployed over the internet, on a local area network, or personal computer. With SaaS, a provider licenses an application to customers either as a service on demand, through a subscription, in a "pay-as-you-go" model, or (increasingly) at no charge where there is opportunity to generate revenue from streams other than the user. Knowledge gathering can be categorized in the second category because of the great interest in gathering knowledge from different sources. This way, you may provide a SaaS free of charge to a potentially very large number of people and organizations, and in return gather lots of knowledge.

SaaS has become a common model for many business applications including accounting, collaboration, customer relationship management (CRM), enterprise resource planning

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(ERP), invoicing, human resource management (HRM), content management (CM), and service desk management.

3.1.3. Cloud Deployment Models and Knowledge Management

Service models described in the definition of cloud computing provided by NIST, can be deployed in the clouds in different ways. Based on these ways, we can have different deployment models depicting the way users and owners of a cloud can deploy and use its services. There are four main deployment models:

1- Private Cloud: is a cloud that is used merely by one organization. The cloud can be provided either by the same organization that uses it, or by a third-party cloud provider.
2- Public Cloud: is a cloud that can be used (possibly for free) by the public. Providing public clouds requires vast investments and is usually limited to very large IT companies like Amazon, Google and Microsoft.
3- Community clouds: is a cloud that can be used commonly by several specific organizations and is provided and developed based on their specific requirements.
4- Hybrid Cloud: can be any combination of three cloud deployment models mentioned above. Hybrid clouds allows for "cloud bursting" in which a private cloud can turn into a public cloud if it needs more resources.

3.2. Cloud Computing and Knowledge management

Definition1: Knowledge as a Service (KaaS) is a subtype of SaaS (software as a service) provided by a knowledge service provider, in which, a knowledge provider answers queries presented by some knowledge consumers, via the knowledge services.

Definition2: KMaaS is a SaaS, in which, knowledge management services are provided by KMaaS service providers and are consumed by KMaaS service consumers. The difference between KaaS and KMaaS is that the former provides facilities on knowledge

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itself, while the latter provides management services to the consumers. KaaS is a part of KMaaS.

As discussed before, knowledge can be generally categorized in two main categories: Tacit knowledge mostly includes implicit mental models, experiences of individuals, know-how, perceptions, and is difficult to transfer, and subjective (highly personal, accumulated through learning and experiences) which can be called people-bound [21] . On the contrary, explicit knowledge includes formal models, rules, procedures, more precise and formal, systematic, easy to codify, reuse, communicate, share, and objective. It can be called system-bound [21] . However, organization has not the pure tacit or explicit knowledge, but a combination of both. Lundval and Johnson [22] divided tacit knowledge into (i) know-how, consisting the practical capability to execute specific activities and (ii) know-who, which involves information about who knows what, who knows how.

Similarly, explicit knowledge also has been divided into (i) know-what, which is the knowledge about facts close to what is defined information, and easy to transfer and (ii) know-why, which refers to scientific knowledge of rules.

In this regard, we can study the relationship between different types of cloud deployment and tacit and explicit knowledge. Table 1 shows this relationship in terms of the level of access to knowledge types in each deployment model. In private clouds access to explicit knowledge is local and limited to the organization that owns the cloud. In fact, it seems to have little effect on the access to explicit knowledge, since there is little difference between a private cloud and a local knowledge management system since a KMaaS deployed on a private cloud seems to have little effect on accessing tacit knowledge, as well, since it is private. On the contrary, in a publicly-deployed cloud that implements a KMaaS, great levels of access to tacit and explicit knowledge is provided, this is more outstanding for tacit knowledge which is inherently resident in more resources over the cloud users (humans' minds). Community clouds stand in a position in between the two above, since it is neither fully private nor fully public, but shared among

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definite organizations. Therefore, access to tacit and explicit knowledge is neither as limited as in private clouds, nor is it as open as in public clouds, however, tacit knowledge is more accessible, because of the mentioned reason stated for public clouds. The access level to knowledge in hybrid clouds depend on the combination of clouds that comprise a hybrid cloud, and thus it is complex to analyze.

Table1. Access to knowledge in different cloud deployment models

	Explicit Knowledge	Tacit Knowledge
Private	Local/limited	Local/ very limited
Public	Very large	Extremely large
Community	Shared/limited	Shared/unlimited
Hybrid	Depends on the cloud types included	Depends on the cloud types included

Knowledge can be of internal environment of organization such as policy, strategy, culture, internal processes, and external environment such as knowledge about markets, customers, competition, technology trends or government policy.

The knowledge domains are viewed from different perspectives depending on the organization type and the context of research. Beijerse [21] presents three knowledge domains. *Organization knowledge* deals with management in the organization such as policy, culture, personnel, career planning, internal processes, cut backs, alliances and teamwork. *Marketing knowledge* is about the external environment such as competition, suppliers, customers, markets, target groups, consumers, clients, users, interested parties, trade and distribution and relation management. *Technological knowledge* is knowledge of products, research and development, core competencies, technological development, information and communication technology and product development.

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Therefore, from another point of view, we can analyze access to knowledge from the aspect of the position of different cloud deployment models. That means whether a cloud is owned by a given organization (whether it is internal to the organization) or they reside on another organization's site (external to that given organization). Additionally the impact of the cloud deployment types on the types of knowledge accessible can be analyzed. Table 2 shows the analysis. While access to the knowledge of an external private cloud is impossible, internal private clouds provide limited local organizational knowledge. Generally speaking, external clouds –except the private ones- provide inter-organizational knowledge, while internal clouds provide intra-organizational (local) knowledge. External clouds –except private ones- provide all knowledge domain types. Amongst the different cases, public external clouds provide unlimited access to the knowledge, while community external clouds provide limited access to knowledge and hybrid external clouds are not always accessible in a constantly limited or unlimited fashion. On the other hand, internal clouds provide limited access to at most two types of knowledge domains: organization and technological.

Table 2. Access to knowledge domains on different types of clouds

	Internal	External
Private	Limited Local organization knowledge	Inaccessible
Public	Limited Local organization/technological knowledge	unlimited inter-organizational external organization/technological/marketing knowledge
Community	Limited Local organization/technological knowledge	limited inter-organizational external organization/technological/marketing knowledge
Hybrid	Limited Local organization/technological knowledge	Limited/unlimited inter-organizational external organization/technological/marketing knowledge

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A third analysis can be carried out on the access levels to knowledge types (tacit/explicit) using different cloud deployment models. Access to both types of knowledge is low when using private clouds. Public clouds allow for higher access to explicit/tacit knowledge, while the tacit knowledge is more at reach. Community clouds provide low to medium access to knowledge types and finally, hybrid clouds, being a combination of all other types, is generally providing medium access, harder to analyze (Table3).

Table3. Access levels to knowledge types using different cloud deployment models

	Explicit knowledge	Tacit knowledge
Private	Low	Low
Public	Hi/medium	Hi
Community	Medium/low	Medium
Hybrid	Medium (mixture)	Medium (mixture)

3.3. KMaaS Services

The interconnected global environment of today is very fast changing. Knowledge workers need to obtain correct knowledge, which is neither too little nor too much, and is action-oriented, leading to valuable result for them and providing the potential for sharing value-added knowledge back into the environment. People need to obtain and share the knowledge in an environment in which there is a daily increasing information overload, while being restricted to intra-organizational knowledge is insufficient and hard-to-retrieve [23] .In order to design a Knowledge Management as a Service, we should first determine what services are necessary for deploying the KMaas on the cloud, irrespective of the deployment model. Table 4 lists the mandatory services that a KMaaS should implement.

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Table 4. mandatory services that a KMaaS should implement

KMaaS Service Types	Function/ Responsibility
Knowledge Finder Services	Responsible for finding proper tacit/explicit knowledge from proper internal or external resources (cloud services)
Knowledge Services	Responsible for delivering knowledge to a knowledge consumer by a knowledge provider
Knowledge Access Control Services	Responsible for managing, monitoring and controlling access to some given knowledge which resides on the organization's cloud
Knowledge Gathering Services	Responsible for gathering proper tacit/explicit knowledge from proper internal or external resources (cloud services) which are either found by knowledge finder services or by knowledge workers themselves
Knowledge Distribution Services	Responsible for distributing the produced knowledge to the knowledge requestors (knowledge consumers)
Knowledge Inference Services	Responsible for inference, learning, … from explicit knowledge, as well as turning tacit knowledge into explicit knowledge if possible
Knowledge Storage and Retrieval Services	Responsible for storing and retrieving knowledge plus knowledge about knowledge to/from a local knowledge base
Knowledge Integration Services	Responsible for maintaining the meta-knowledge, describing the knowledge elements that come from a variety of resources
Personalization Services	Provide proper and desirable access to knowledge elements, preventing information overload.

Every KMaaS will have to implement the services mentioned in table 4. However, the services are not at all limited to them. Some more services include the following shown in table 5. Moreover, it is important to mention the dependency relationship among different services in the KMaaS architecture. Figure 3 depicts the dependencies.

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Table 5. Some optional Services of a KMaaS

KMaaS Services (Optional)	Function/ Responsibility
Crowd sourcing	Responsible for presenting a problem to numerous knowledge workers and problem solvers
Expert mediation	Most of the times, knowledge workers are not sure or do not know what exactly will help them in a situation; expert mediation service is responsible for providing a way to figure out what can help them better.
Long tail services	Responsible for analyzing the 10% portion of the problem that its solution will provide the 90% benefit
Knowledge pusher services	Responsible for putting knowledge in access of the clients (pushing), instead of limiting clients to pull knowledge from the resources (e.g. by searching)

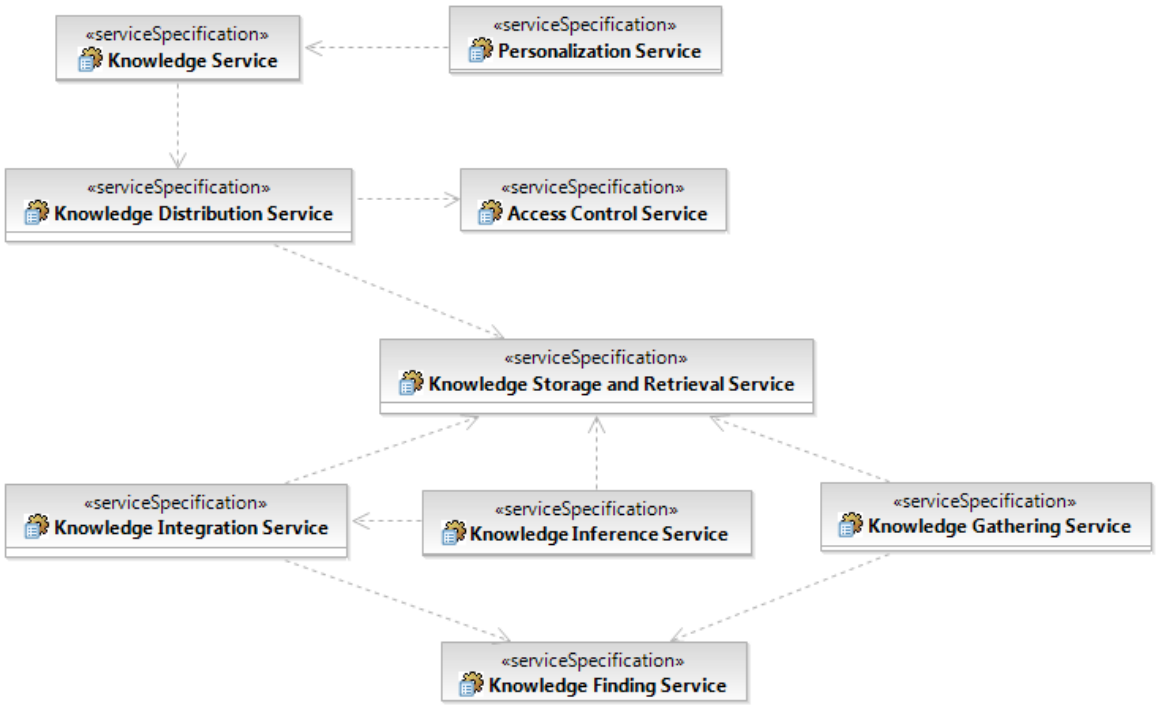

Fig. 3. dependency relationships among KMaaS services

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The overall architecture will be as figure 4 depicts.

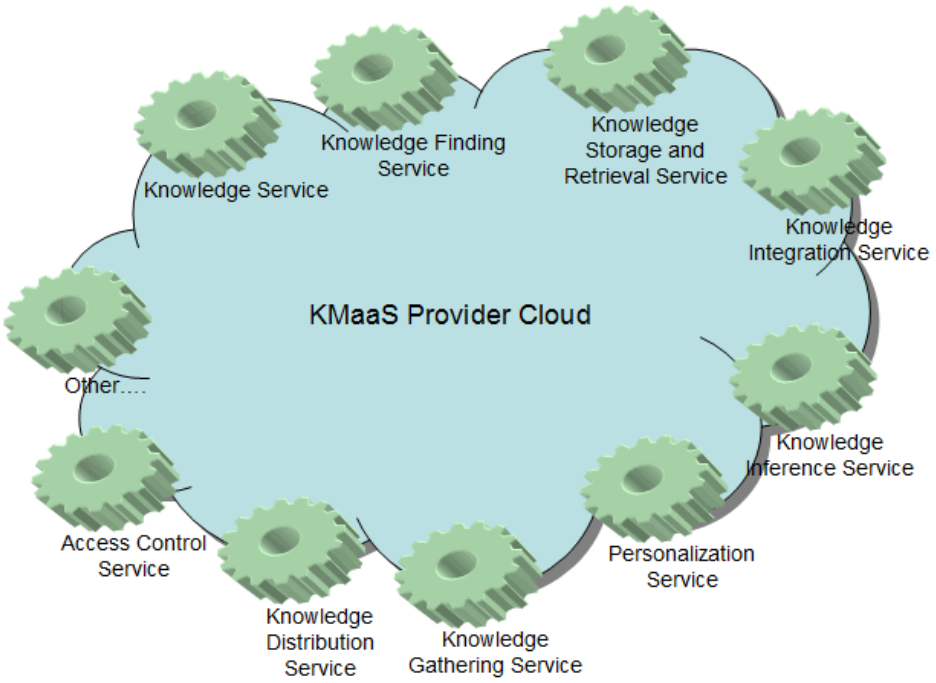

Fig. 4. overall architecture of the KMaaS

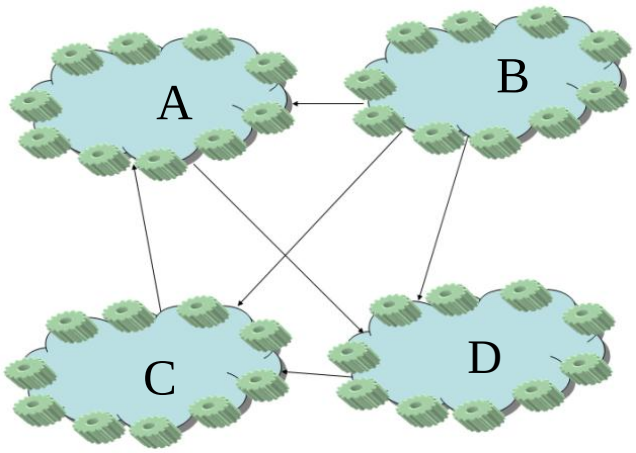

Fig. 5. KMaaS clouds intercommunication

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Several KMaaS clouds can be interconnected to provide proper services to different parties. One cloud can be a KMaaS Provider, a KMaaS Consumer or both. For example, cloud B is only a KMaaS provider, while cloud D is both a KMaaS provider and a KMaaS consumer. A KMaaS Provider/Consumer is not always another cloud or KMaaS; it may be a human (knowledge worker) or a device as well.

4. KMaaS Application Scenarios

KMaaS can have several use cases related to knowledge management, creation, distribution, etc. In this section, we will provide a several application and usage scenarios.

Scenario1. Suppose that in organization A, which is not implementing a KMaaS, a knowledge worker needs to solve a knowledge problem, a simple scenario is to connect to a KMaaS service and request knowledge. If the response is not acceptable, another KMaaS should be found and the request should be resent to the new cloud. In charge of finding the proper resource, is the knowledge worker. If the knowledge worker does not exactly know what they want, or in other words, if they do not know or are not sure what knowledge exactly will help them, this effort will be time-consuming and relatively hard to follow.

Scenario2. Organization B, which implements a KMaaS, will deal with knowledge problems more easily. If a knowledge worker needs to solve a knowledge problem, the problem can be presented to "knowledge finding service", which will in turn, get connected to other KMaaS clouds to look for proper knowledge. The found pieces of knowledge will be gathered and probably stored in the knowledge base. The "knowledge inference service" may be used to inference and learn from the knowledge pieces to get to a valuable result. "Knowledge integration service" will also be used to maintain or check the meta-knowledge to help intelligence applications (BI,CI, etc.) extract proper knowledge and to inference and learn from it using inference service. It is obvious that the “distribution service” can be used to deliver the results to proper consumer, whether the preliminary resource, or any other external/internal consumer, being a knowledge

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worker, an application or KMaaS, or even a device. The KMaaS service that has responded to the knowledge request is a "knowledge service".

Scenario3. Organization C, which has deployed a private KMaaS, can benefit from other public (or generally accessible) KMaaS, while protecting its critical knowledge from any access, via the "access control service".

Scenario4. Organizations D, E and F, have deployed community KMaaS instances to establish a virtual-organization knowledge management solution. In charge of access-control is the access control service. Personalization service helps each knowledge worker in each organization to have their desired settings for having proper filters on the knowledge to prevent an overload of undesired knowledge.

Scenario5. Organization G, maintains the meta-knowledge via the integration service to help the knowledge workers and other services to extract specific needed information. The meta-knowledge may include the format of the knowledge (general/specific) and other key information such as tags to provide a way to categorize knowledge instances. This will help in learning from tacit knowledge as well as explicit knowledge, which is a responsibility of knowledge inference service.

Scenario6. Organizations or people that are not benefiting from a KMaaS can also participate in distributing and sharing their knowledge with others. Organization H implements a bonus system for those who add a knowledge piece, e.g. an experience, to their knowledge base, building up an Experience Management as a Service (can be done via knowledge pusher service), which will be in turn, distributed via “knowledge distribution service” and “knowledge service” to the requestors. This is a very good way to gather valuable tacit knowledge, especially from the customers and the market in a socio-technical environment.

Scenario7. Organization I implements a "crowd sourcing" service. As soon as a need to knowledge emerges, the problem is imposed to many problem solvers who may or may

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not have a KMaaS. The responses are gathered and decided on. The inference service may be able to learn from the results.

Scenario8. Expert mediation service is included in organization F's KMaaS. This extra service helps the knowledge workers to make sure what exactly will help them in a situation. Thus, the performance of knowledge acquisition highly increases.

Scenario9. Organization J uses long tail service to identify which 10% of the products will make up the 90% of its income. This is achieved by gathering knowledge and learning from market (Market Intelligence).

Scenario10. KMaaS services are not limited to the services introduced in section 3.3. A very important characteristic of the cloud that makes it very strong and suitable for knowledge sharing and gathering, is the capability of social networks and user defined services and applications that can be provided to many people and other KMaaS clouds. Suppose that in the cloud-based social environment, any organization designs its own application via some PaaS, to extract, gather, distribute, learn from and integrate the desired categories of knowledge. These applications usually can be freely used by others, or at a very low cost, that will result in an open environment for creative solutions to the problems in general or specific knowledge areas. This capability is easily provided by the cloud-computing paradigm.

5. Conclusion and Future Work

With the emergence of new technologies and paradigms, businesses have to get aligned with them, especially in knowledge management area. Cloud Computing paradigm is becoming more and more popular, due to its specific characteristics.
These characteristics include:

- Decrease in time, cost and effort for meeting software development needs
- Scalability
- Reliability
- Security

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- Ease of deployment and management
- Trust
- Privacy
- Availability
- Performance
- Ownership and more

It also provides a great infrastructure for gathering and redistributing knowledge. Therefore, it has a great capability for providing knowledge management services that can be used extensively for business intelligence and competitive intelligence. Currently these capabilities are not utilized for knowledge management in intra- and inter-organization businesses. In this paper, we introduced the architecture of KMaaS and its services, their relationships and dependencies. We also analyzed how different cloud deployment models can be used for knowledge management in the cloud environment.

Knowledge and knowledge management is a crucial factor for enterprise intelligence, including market intelligence (MI), business intelligence (BI), competitive intelligence (CI) and strategic intelligence (SI). Therefore, KMaaS is very effective in these areas. Business intelligence is almost meaningless without knowledge management.

KMaaS is very helpful in upgrading the capabilities and the vastness of the knowledge utilizing opportunities offered by cloud computing paradigm, making it compliant with the newest advances in the technology. KMaaS is specifically crucial in competitive intelligence, since it helps the organization that deploys a KMaaS to gain very richer knowledge compared to the competitors that do not deploy it. That's because the KMaaS-equipped organization has a great access to the best practices, experiences, and knowledge about market, customers, suppliers and even the competitors. KMaaS also helps the organization develop stronger and better strategies, since it can gather and learn from an extremely large knowledge gained from multiple resources, including people, knowledge workers, applications, other systems and other KMaaS services, which are public (or generally accessible). Market intelligence can also benefit from KMaaS services utilizing the knowledge and the experiences and best practices that are gained from the market and the customers. As the future work we plan to introduce and study

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Experience Management as a Service to provide practical solutions to a vast area of tacit knowledge management in the cloud environment which is tightly relevant to the social networks. Moreover, the performance of a KMaaS or an EMaaS can be analyzed by statistical and mathematical analyses on the relationship graphs that exist between different clouds that are communicating knowledge via KMaaS or EMaaS.

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