Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/ 9288
DOI URL: http://dx.doi.org/10.21474/IJAR01/9288
ISSN NO. 2320-5407

RESEARCH ARTICLE

A WATERFALL MODEL FOR KNOWLEDGE MANAGEMENT AND EXPERIENCE MANAGEMENT.

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Manuscript Info

Manuscript History
Received: 15 April 2019
Final Accepted: 17 May 2019
Published: June 2019

Key words:-
Knowledge management, experience management, knowledge based systems.

Abstract

This paper examines experience and knowledge, experience management (EM) and knowledge management (KM), and their interrelationships. It then proposes waterfall models for both EM and KM. The models characterize EM and KM as the integration of experience processing and corresponding management, that of knowledge processing and corresponding management respectively. The proposed approach will facilitate research and development of KM, EM, and hybrid intelligent systems.

Introduction:-

While knowledge management (KM) has become well established in business management, artificial intelligence (AI), and information technology (IT) with books, conferences, commercial tools and journals on the topic [3][6], experience management (EM) has received a small amount of research attention [1].

While knowledge has received considerable attention in the above areas, experience has not drawn the similar attention. In particular, how to automate experience based on intelligent techniques is still a big issue.

However, without any doubt there is a close relationship between experience and knowledge. For example, experience could be considered a refinement of knowledge or a special instance or form of knowledge. Therefore, it is important to examine the relationship between experience and knowledge, EM and KM and their interrelationships. This paper will fill in this gap. To this end, the remainder of the paper is organized into the following sections: Section examines knowledge, experience and their relationship. Section 3 and 4 propose waterfall models for both KM and EM, and also look at their interrelationships. The final section ends the paper with some concluding remarks.

Knowledge and Experience

Knowledge and experience are both intelligent assets of human beings. They have been emphasized in a different way although they have a close relationship.

There is no consensus on what knowledge is. Over the millennia, the dominant philosophies of each age have added their own definitions of knowledge to the list. In computer science, knowledge is defined as the objects, concepts and relationships that are assumed to exist in some area of interest [14].Various knowledge exists in encyclopedias, handbooks, manuals, other reference materials, lectures, the head of human beings, and the WWW, in particular.

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Knowledge became an important construct in AI in the 1970's. At that time, AI researchers believed that more powerful intelligent systems required much more built-in knowledge about the domain of application [9]. Knowledge has been a central part for knowledge based systems (KBS) since the 1980's [14].

Knowledge has also played a pivotal role in business management (BM) and information management (IM) [6]. How to find useful knowledge from a large database or from the Web to assist decision making has become one of the most important issues in data mining and BM.

However, any investigation into knowledge without taking experience into account seems to be less meaningful. Generally speaking, experience can be taken as previous knowledge or skill one obtained in everyday life [13][14]. In other words, experience is a form of previous knowledge, which consists of problems one has met and the successful solution to the problem. Therefore, experience can be taken as a specialization of knowledge.

In CBR (case-based reasoning), a piece of experience is denoted as a case [5]. All cases are stored in a case base. A previous experience, which has been captured and learned in a way that it can be reused in the solving of future problems, is referred to as a past case. Correspondingly, a new case is the description of a new problem to be solved and its possible solution. Therefore, a case in CBR is an operational definition of experience. CBR uses cases to deal with how to save, retrieve, reuse, retain, and revise experience in a special setting such as in e-commerce [14].

What the difference is between experience and knowledge is an interesting topic, because it is the basis for differentiating EM from KM. In what follows, we try to use Q-A-R (Question-Answer-Remark) method to differentiate them with some comments.

1. Q1: Why are you going to study at your school?
2. A1: I am going to study to gain knowledge.
3. R1: Few say that "I am going to study to gain experience"
4. Q2: Why did you visit that old doctor?
5. A2: Because he has rich experience in diagnosing and treating the disease that I suffered.
6. R2: The knowledge of the doctor in diagnosing and treating the mentioned disease is not sufficient to attract the customer to see the doctor. That is, experience is a more important asset than knowledge in some fields.
7. Q3: Have you drawn some lessons from that experience?
8. A3: Yes, I have.
9. R3: One seldom asks "Have you drawn some lessons from that knowledge?"

From the above Q-A-R consideration, we see that experience and knowledge are two different concepts. Experience may be more important than knowledge to deal with some tough problems. Accumulation of knowledge is the necessary condition of accumulating experience for a field expert. However, knowledge and experience are abstractions at two different levels [13]. Experience is at a higher level. From a historical viewpoint, transforming the experience of a human being into knowledge has always been an important topic in science and technology. On the other side, knowledge accumulation and distillation might lead to new experience.

Knowledge Management and Its Waterfall Model

KM is a discipline that focuses on knowledge processing and corresponding management which permeates each of following processing stages[2][6][7]:

1. Understand knowledge
2. Discover knowledge
3. Capture, and acquire knowledge from a variety of sources
4. Select, filter and classify the existing knowledge
5. Define storage structures for saving knowledge
6. Design ontology of knowledge
7. Generate, adapt and/or create new knowledge
8. Measure and/or evaluate knowledge
9. Visualize knowledge
10. Distribute and/or transfer knowledge to other organizations or individuals
11. Recommend, share, utilize/apply and sell knowledge
12. Retain and maintain knowledge as an asset.

The management of knowledge processing for each processing stage includes analysis, planning, organization [7], support, collaboration, coordination and possible negotiation. Using a software engineering methodology [12], we can then propose a waterfall model for KM, based on the above discussion, as shown in Fig. 1.

It should be noted that the proposed waterfall model of KM can only cover some aspects of KM, although it tries to cover the majority of these, compared to the KM tasks given in [7], where the parts of KM consists of focus, find, elicit, organize, package, share, apply, evaluate and adapt tasks.

Further, the history of human civilization can be considered as the history of KM and EM, at least since the invention of papermaking (in AD 105) and printing technology (around 1041-48) 3 . Modern KM just began after the inception of electronic computers in 1945 although the term KM was introduced at the end of last century [2]. Since then, all the mentioned processing stages have been examined based on modern information technology (IT). With the dramatic development of the Internet and the WWW at the end of last century, KM has been drawing increasing attention from researchers and companies, because "the basic economic resource is no longer capital, nor natural resources. It is and will be knowledge" [4]. In what follows, we will discuss the proposed model in some detail.

First of all, we have simplified the description of activities in the processing stages in the waterfall model. For example, we use "knowledge acquisition" to denote all activities of capturing and acquiring knowledge from a variety of sources mentioned earlier, in order to make the model concise.

The sequence of the processing stages is also pragmatic rather than precise; the processing stages may also not be executed sequentially, because some latter processing stages sometimes is a basis for some former processing stages. For example, knowledge ontology is an explicit specification of conceptualization of knowledge of a domain at a general level [1]. Knowledge ontology, like the relational schema of a relational database, is the basis for further processing knowledge including storage, generation, creation, and classification.

Knowledge understanding includes knowledge learning. In most cases, knowledge understanding is the goal of knowledge learning, while knowledge understanding can promote further knowledge learning. Knowledge understanding is the basis for knowledge creation.

Knowledge creation is sometimes also a consequence of knowledge sharing, which is valid, in particular, in some organizations,

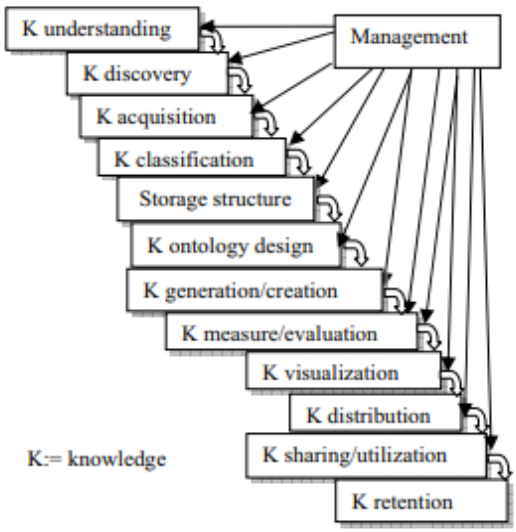

Fig 1:-A waterfall model of knowledge management

in which the opportunities for the creation of new idea or knowledge that have the potential to add value to it increase because of a developing knowledge sharing environment [8].

These examples imply that either iterative or spiral processing models of KM should be introduced in order to reflect the interrelationship between the processing stages in the waterfall model, which will be done in further work. In what follows, we turn to two perspectives for this proposed model: A researcher viewpoint, and an organizational viewpoint.

From a researcher viewpoint, each of the mentioned processing stages can be considered as a research field. That is, each of them still requires further systematic investigation, optimization, and automation. Most of researchers in KM usually focus on a few processing stages of the proposed model. Few researchers have studied all the processing stages thoroughly.

From an organizational viewpoint, an organization focuses on one stage or some stages of the model in order to maximize the profits. For example, one company only develops the knowledge visualization software and then sell its software to help its customer with facilitating knowledge visualization.

In order to formulize the above consideration, we assume that
KM ={<KU,M>, <KD,M>, <KA,M>, <KC,M>, <SSD,M>, <KOD,M>, <KGC,M>, <KME,M>, <KV,M>, <KDi, M>, <KSU,M>}

Where, KM is considered as a set consisting of eleven elements, each of which corresponds to a processing stage in the knowledge processing and its management (M for short).

For example, denotes knowledge distribution (KDi) and its corresponding management (M). From a set theoretical viewpoint, 2^{KM} consists of all possible subsets of KM, each of the subsets in 2^{KM} corresponds to the research interests of a researcher, or business activities of a company. For example, {<KV,M>, <KDi,M>} ε , 2^{KM} consists of knowledge visualization (KV), knowledge distribution and their management, which are the business activities of a publisher.

It should be noted that from the history of modern computing, any reasonable abstraction from data has facilitated the research and development of IT. For example, the abstraction from data to information leads to the fast development of information engineering and information management (IM) [14]. Based on this idea, we can see that the abstraction processing from data to experience requires corresponding processing technology such as data processing and knowledge processing, which further involve data management (DM) and KM respectively [13][14]. Therefore, human-level experience processing also requires EM. Just as DM and KM have played an important role in IS and AI, EM will also play an important role in IS and e-commerce.

Experience Management and Its Waterfall Mode
This section examines EM, proposes a waterfal model, and looks at the interrelationship between KM and EM. It will also discuss inheritance from knowledge to experience.

From an object-oriented viewpoint [12], a subclass Y inherits all of the attributes and methods associated with its superclass X; that is, all data structures and algorithms originally designed and implemented for X are immediately available for Y [10]. This is the inheritance or reuse of attributes and operations. Methodologies, techniques and tools for KM can be directly reused for EM, because EM is a special kind of KM that is restricted to the management of experience knowledge [2]. On the other hand, experience has some special features and requires special methods different from that of knowledge. Therefore, two issues are very important for EM:

1. What features of EM are different from that of KM?
2. Which special processing stages does EM require?

In what follows, we will try to resolve these two issues. First of all, we define that EM is a discipline that focuses on experience processing and corresponding management which is in each of the following processing stages [2]:

1. Discover experience
2. Capture, gain and collect experience
3. Model experience
4. Store experience
5. Evaluate experience
6. Adapt experience

7. Reuse experience
8. Transform experience into knowledge
9. Maintain experience.

In these processing stages, "maintain experience" includes update the available experience regularly, while invalid or outdated experience must be identified, removed or updated [2]. Transform experience into knowledge is an important processing stages for EM, which is the unique feature of EM different from those of KM. In the history of human beings, all invaluable experience is gradually transformed into knowledge, which then is spread widely in a form of books and other means.

Experience creation and generation is basically beyond the scope of EM [2], whereas knowledge creation and generation is a necessary processing stage of KM. Discovery of knowledge from a huge database has become an important research field: data mining and knowledge discovery [9], while discovery of experience from a collection of knowledge is still a big issue for EM [13].

Based on the above discussion, we propose a waterfall model for experience management, as shown in Fig. 2.

It should be noted that for the processing model of both EM and KM there are a knowledge base and experience base respectively, although we have not illustrated them graphically

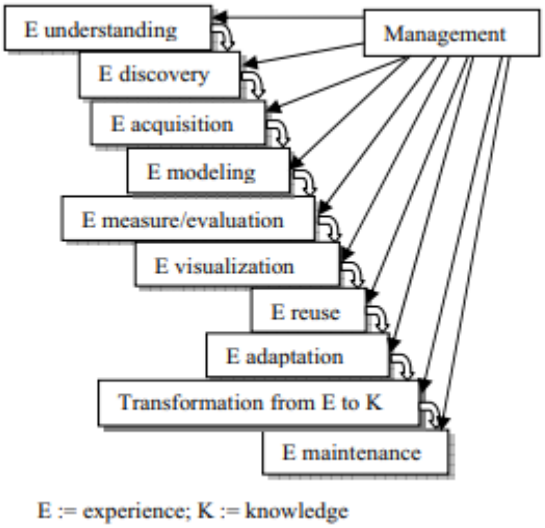

Fig 2:-A waterfall model of experience management

Concluding Remarks

This paper examined experience and knowledge, EM and KM, and their interrelationships. It then proposed waterfall models for both EM and KM, which integrate experience/knowledge processing and corresponding management respectively. The proposed approach will facilitate research and development of KM, EM, and hybrid intelligent systems.

EM research will provide a new way of looking at data, knowledge, experience and their management for organizations. This will include experience retrieval, experience similarity, and experience processing. Successful solution of these problems could provide the basis for new advances in KM and EM.

In future work, we will develop hybrid intelligent techniques for EM. We will also develop a system prototype for multiagent EM systems, which can be used for business negotiation and brokerage.

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