1-1-2005

Experience management in knowledge management

Zhaohao Sun
University of Wollongong, Wollongong, NSW

Gavin Finnie
Bond University, Gavin_Finnie@bond.edu.au

Experience Management In Knowledge Management

Zhaohao Sun, Gavin Finnie*

School of Economics and Information Systems, University of Wollongong, NSW 2522 Australia
zsun@uow.edu.au
* Faculty of Information Technology, Bond University Gold Coast Qld 4229 Australia
gfinnie@staff.bond.edu.au

Abstract: This paper examines experience and knowledge, experience management and knowledge management, and their interrelationships. It also proposes process perspectives for both experience management and knowledge management, which integrate experience processing and corresponding management, knowledge processing and corresponding management respectively. The proposed approach will facilitate research and development of knowledge management and experience management as well as knowledge-based systems.

Keywords: Knowledge management, experience management, knowledge-based systems, e-commerce.

1 Introduction

While knowledge management (KM) has become well-established in information systems (IS), business and management, artificial intelligence (AI), and information technology (IT) with books, conferences, commercial tools and journals on the topic [12], experience management (EM) has received a small amount of research attention. There have been two German workshops on EM [18]. In addition, research on a tool called the experience factory that has been used to store and retrieve experience in software development projects has led to some commercial product development [19].

While knowledge has received considerable attention in the above mentioned areas, experience has not drawn similar attention [13]. In particular, how to automate experience based on intelligent techniques and software engineering methodology 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 [14]. Therefore, it is significant to examine the relationship between experience and knowledge, EM and KM and their interrelationships. To this end, the remainder of this paper is organised into the following sections: Section 2 examines knowledge, experience and their relationships, Section 3 and 4 looks at KM, EM and their interrelationships. The final section concludes the paper with some concluding remarks.

2 Knowledge and Experience

Knowledge and experience are both intelligent assets of human beings. They have been emphasised 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 definition of knowledge to the list. Knowledge as a construct or an atom is defined as "understanding the cognitive or intelligent system possesses that is used to take effective action to its system goal" [16]. In computer science, knowledge is usually defined as the objects, concepts and relationships that are assumed to exist in some area of interest [13]. Various knowledge exists in encyclopaedias, handbooks, manuals, other reference materials, speeches, lectures, the head of human beings, and the Internet/WWW, in particular.

Knowledge became an important construct in AI in the 1970's, although there are no definitions of knowledge in some books on AI such as Ref. [9]. At that time, AI researchers believed that more powerful intelligent systems required much more built-in knowledge about the domain of application [9] (p 10). With knowledge-based systems (KBS) becoming an important application of AI in the 1980's, knowledge is a central part of KBS, in which the knowledge base and inference engine are main parts [13] (p 13).

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

However, any investigation into knowledge without taking into account experience seems to be less meaningful, although it is not easy to define what experience is, just as it is hard to define what knowledge is. Generally speaking, however, experience can be taken as previous knowledge or skill one obtained in everyday life [13] (p.13). For example, Peter avoided a traffic tragedy on Pacific highway yesterday, because he drove carefully and focused on the drive. This is a typical experience for driving. In other words, experience is previous knowledge which consists of problems one has met and the successful solution to the problems. Therefore, experience can be taken as a specialization of knowledge.

In CBR terminology, a piece of experience is denoted as a case [13]. All cases are stored in a case base. Therefore, a case base is essentially an experience 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, previous case, stored case, or retained case. Correspondingly, a new case or unsolved case is the description of a new problem to be solved and its possible solution.

So far, we have discussed knowledge, experience and their relationships. What the difference is between them is an interesting topic, although few in AI, Information Systems, KM and EM give a deep insight, because it is the basis for differentiating KM from KM. In what follows, we try to use Q-A-R (Question-Answer-Remark) method to differentiate them with some comments [12].

Q1: What are you going to study in your school?

A1: I am going to study to gain knowledge.

R1: Few say that "I am going to study to gain experience"

Q2: Why did you visit that old doctor?

A2. Because he has rich experience in diagnosing and treating the disease that I suffered.

R2: In this case, the knowledge of the doctor in diagnosing and treating the mentioned disease is not sufficient to attract the customer to see the doctor. This is a common sense. That is, experience is a more important asset than knowledge in some field. Therefore, in diagnosis, a doctor's experience can be considered the kernel of his possessed knowledge.

Q3: What are you doing?

A3: I am collecting experience

R3: One seldom says "I am collecting knowledge"

Q4: Have you drawn some lessons from that experience?

A4: Yes, I have

R4: One seldom asks "Have you drawn some lessons from that knowledge?"

From the Q-A-R consideration, we see that experience and knowledge are two different concepts. Furthermore, possessing knowledge is only one necessary condition for a field expert [13]. Experience may be more important than knowledge for a field expert 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. Experience is at a higher level, because because experience is a meta-knolwdge in some cases [13]. 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.

3 Knowledge Management

As mentioned previously, knowledge management (KM) has become well-established in IS, IM, and AI [3][6]. However, KM is also a new and exciting research topic in these and other fields such as business management and business decision making. KM is being viewed by organisations as providing the capability of improving competitiveness and increasing internal efficiency by facilitating the leveraging of existing knowledge within the organisation. This is achieved by providing a centralised repository for knowledge which is then accessible as needed. More specifically, KM is a discipline that focuses on knowledge processing and corresponding management that permeates each of following process stages [6][7][12]:

- Understand knowledge
- Discover knowledge
- Capture, and acquire knowledge from a variety of sources
- Select, Filter and classify the existing knowledge
- Define storage structures for saving knowledge
- Design ontology of knowledge
- Generate, adapt and/or create new knowledge
- Measure and/or evaluate knowledge according to the objective of an organisation development
- Visualise knowledge
- Distribute and/ transfer knowledge to other organisations or individuals commercially or non-commercially
- Recommend, share, utilise/apply and sell knowledge
- Retain and maintain knowledge as an asset.

It is significant to separate management function from knowledge processing functions, and then integrate them in KM. This is also one of the characteristics of this paper, as shown in Fig. 1.

The management of knowledge processing for each process stage includes analysis, planning, organisation, support, collaboration [7], coordination and possible negotiation [12]. Generally speaking, management issues related to each or some of the knowledge processing stages include:

- Organisation of team
- Knowledge processing or management task assignment to specific person or teams
- Member and team communication and coordination.

Knowledge understanding includes knowledge learning, which is an important part for students in schools. In most cases, knowledge understanding is the goal of knowledge learning, while knowledge understanding can promote further knowledge learning.

Knowledge creation is sometimes also a consequence of knowledge sharing, which is valid, in particular, in some organisations, in which the opportunities for the creation of new idea or knowledge that have the potential to add value to it increases because of a developing knowledge sharing environment [8].

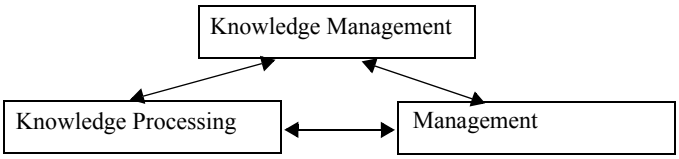

Fig. 1. KM as integration of knowledge processing and management

In a most general sense, the history of human civilization (culture) can be considered as the history of knowledge management, at least since the invention of papermaking (in AD 105) and printing technology (around 1041- 48)[1]. Therefore, a real KM would cover a majority of human activities in culture development. This is the reason why it is difficult for a process model to cover all possible activities in KM [12]. However, from a narrower sense, modern KM just began after the inception of modern computers after World War II in 1945 although the term KM was introduced at the end of last century [2] (p 9). Since then, all the mentioned process stages have been examined and developed based on modern information technology. With the dramatic development of the Internet and the WWW at the end of last century, KM has been drawing increasing attention from both researchers and companies, because "the basic economic resource is no longer capital, nor natural resources. It is and will be knowledge" [4].

There are two perspectives for KM: One is from a researcher viewpoint, another is from an organisational viewpoint [12]. From a researcher viewpoint, each of the mentioned process stages can be considered as a research field or research topic. That is, each of them still requires further systematic investigation, and optimisation and automation based on information technology. Most of researchers in KM usually focus on a few process stages of the proposed model. Few researchers have studied all the process stages thoroughly or in parallel. From an organisational viewpoint, in particular, from a business viewpoint, an organisation or a company also focuses on one stage or some process stages in order to maximize the profits from the activities in KM. For example, one company only develops the knowledge visualization software and then sell its software in order to help its customer with facilitating knowledge visualization and knowledge distribution and utilization.

In order to formalize the above consideration, we assume that

1. See http://www.printersmark.com/Pages/Hist1.html

KM = {<KU, M>, <KD, M>, <KC, M>, <SSD, M>, <KOD, M>,
<KGC, M>, <KME, M>, <KV, M> <KDi, M>, <KR, M>, <KRM, M>}

Where, KM is considered as a set consisting of eleven elements, each of which corresponds to a process stage in the knowledge processing and its management (M for short). For example, <KDi, M> denotes knowledge distribution and its corresponding management. 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>} $\in 2^{KM}$ consists of knowledge visualization, knowledge distribution and their management, which are the business activities of a publisher.

It should be also 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 led to the fast development of information engineering and IM [13]. Based on this idea, we can see that the abstraction process from data to experience requires corresponding processing technology such as data processing, information processing, knowledge processing and experience processing which further involve data management, IM, KM (including intelligent agents and ES) and EM respectively. That is, human-level experience processing also requires EM. Just as data management, IM, and KM have played an important role in IT, IS, and AI, EM will also play an important role in IS and e-commerce.

4 Experience Management

In this section we examine experience management (KM) and look at the interrelationship between KM and EM. At the same time, we will also discuss inheritance, *specialization and generalization* from knowledge to experience, which will lead to some characteristics of EM different from KM.

From an object-oriented viewpoint [11], 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] (p 551). This is the inheritance or reuse of attributes and operations. As we know, experience can be considered as a special case of knowledge (see Section 2), 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. On the other hand, experience has some special features and requires special methods different from that of knowledge, just as a subclass Y of its superclass X usually possesses more special attributes and operations. Therefore, two issues are very important for EM:

- What features of experience management (EM) are different from that of KM?
- Which special process 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 following process stages [2] (pp 1-14):

- Discover experience
- Capture, gain and collect experience

- Model experience
- Store experience
- Evaluate experience
- Adapt experience
- Reuse experience
- Transform experience into knowledge
- Maintain experience.

In these process stages, "maintain experience" includes update the available experience regularly, while invalid or outdated experience must be identified, removed or updated. Transform experience into knowledge is an important process stages for EM, which is the unique feature of EM different from those of KM. In the history of human beings, almost all invaluable experiences are gradually transformed through induction, summary and publication into knowledge, which then is spread widely in a form of books, journals and others means.

It should be noted that transformation between experience and knowledge is still an open topic from an intelligent system viewpoint. Further, from an IT viewpoint, discovery of knowledge from a huge database has become an important research field, that is, data mining and knowledge discovery, while discovery of experience from a collection knowledge or social practice is also a big issue for EM, because discovery of experience from knowledge or social practice is at a higher level than discovery of knowledge from data.

Similar to the discussion in the previous section, we assume that

EM = {<ED, M>, <EC, M>, <EM, M>, <ES, M>, <EE, M>, <EA, M>,
<ER, M>, <ET, M>, <EM, M>}

Where EM is considered as a set consisting of ten elements, each of which corresponds to a process stage in the experience processing and its own management (M for short). For example, <ED, M> is for experience discovery and its own management, and <EA, M> denotes experience adaptation and its own management. Based on set theory, 2^{EM} consists of all possible subsets of EM. Each of the subsets in 2^{EM} corresponds to a kind of business activities or research interests of some researchers. For example, {<EA, M>, <ER, M>} can be considered as the activities of novice in his/her work.

5 Concluding Remarks

This paper examined experience and knowledge, EM and KM, and their interrelationships. It also examines EM and KM as integration of experience processing and corresponding management, knowledge processing and corresponding management respectively from a process modelling viewpoint.

EM and experience-based reasoning (EBR) research [15] will provide a new way of looking at data, knowledge, experience and their management for organisations. This will include experience structures, experience retrieval, experience similarity, experience processing and experience adaptation, and EBR. Successful solution of these problems could provide the basis for new advances in KM and EM. There is also

significant potential for EBR in opening up a broad new range of applications, not only in business and e-business but in a number of domains such as deception recognition [15].

In future work, we will develop a prototype system for multiagent EBR systems, which can be used for business negotiation and brokerage. We will also develop a spiral model for experience management.

References

[1] Abramowicz W, Kowalkiewicz M, Zawadzki P. Ontology frames for IT courseware representation 2003, pp 1-11. In Cokes E. [3]

[2] Bergmann R. *Experience Management: Foundations, Development Methodology and Internet-Based Applications*. LNAI 2432. Berlin: Springer 2002

[3] Cokes E. *Knowledge Management: Current issues and challenges*, Hershey, PA: IRM Press, 2003

[4] Drucker P. Post-Capitalist Society. New York: Harper Business, 1993

[5] Finnie G, Sun Z. A logical foundation for the CBR Cycle. *Int J Intell Syst* 18(4) 2003, 367-382

[6] Hasan H. Handzic M (eds.). *Australian Studies in Knowledge Management*. Australia: University of Wollongong Press, 2003, 568 p.

[7] McManus DJ, Snyder CA. Knowledge management: The missing element in business continuity planning, in Cokes [3], 2004, pp 79-91,

[8] Mitchell HJ. Technology and knowledge management: Is technology just an enabler or does it also add value? In: Coakes E: *Knowledge management: Current issues and challenges. Hershey*: IRM Press, 2003, 66-78

[9] Nilsson NJ. *Artificial Intelligence. A New Synthesis*. San Francisco, California: Morgan Kaufmann Publishers, Inc. 1998, 513 p.

[10] Pressman RS. *Software Engineering: A Practitioner's Approach* (5th Edn), Boston: McGrawHill Higher Education, 2001, 860 p

[11] Satzinger JW, Jackson RB, Burd SD. *Systems Analysis and Design in a Changing World* (3rd Edn). Course Technology, 2004

[12] Sun, Z. A waterfall model for knowledge management and experience management. In: *Proc. Inter Conf on Hybrid Intelligent Systems* (HIS 2004), December 6-8, Kitakyushu, Japan, IEEE Press, 2004

[13] Sun Z and Finnie G. *Intelligent Techniques in E-Commerce: A Case-based Reasoning Perspective*. Heidelberg: Springer-Verlag, 2004

[14] Sun Z, A waterfall model for knowledge management and experience management.In: *Proc. Inter Conf on Hybrid Intelligent Systems* (HIS 2004), December 6-8, Kitakyushu, Japan, IEEE Press, 2004, pp 472-475

[15] Sun, Z. Finnie G. Experience based reasoning for recognising fraud and deception. In: *Proc. Inter Conf on Hybrid Intelligent Systems* (HIS 2004), December 6-8, Kitakyushu, Japan, IEEE Press, 2004, pp 80-85

[16] Voss A. Towards a methodology for case adaptation. In: Wahlster W (ed.): *Proc 12th European Conf on Artificial Intelligence (ECAI'96)*, John Wiley and Sons; 1996. pp 147-51

[17] Zimmermann HJ. *Fuzzy Set Theory and its Application*. Boston/Dordrecht/London: Kluwer Academic Publishers; 1991.

[18] http://wm2003.aifb.uni-karlsruhe.de/workshop/ w06/GWEM2003_CfP_english.html.

[19] (http:// www.iese.fraunhofer.de/experience_management/)