

**KNOWLEDGE MANAGEMENT SYSTEMS:
A HEALTH CARE INITIATIVE WITH LESSONS FOR US ALL**

Nilmini Wickramasinghe

Computer & Information Science Department, James J. Nance College of Business Administration
Cleveland State University, 1860 East 18th Street, Cleveland, OH 44114-3610, U.S.A.
Tel.: +1 216 875-9803, Fax: +1 216 687-5448
n.wickramasinghe@csuohio.edu

Gail L. Mills

Director, Information Technology, Kaiser Permanente, Ohio, Cleveland, Ohio 44131
Tel.: (216) 749-8400, Fax: (216) 749-8405
gail.mills@kp.org

ABSTRACT

We are not only in a new millennium but also a new era. A variety of terms such as the Post-Industrial Era (Huber, 1990), the Information Age (Shapiro et al, 1999), the Third Wave (Hope et al, 1999) or the Knowledge Society (Drucker, 1999) are being used to describe this epoch. However, whichever term one subscribes to, most are agreed that one of the key defining and unifying themes of this period is knowledge management. From the mid 90s, we have evidenced tremendous investment in knowledge management and knowledge management systems (KMS). Some of the leaders into this knowledge management abyss have been the big consulting companies. These firms started to incorporate knowledge management as a key component of their strategies and business plans as early as the late 1980s. The literature discussing knowledge management and KMS focuses almost exclusively on this sector. However, KMS are useful in other sectors too. Furthermore, they are prevalent in these other sectors. One area KMS are present, yet the literature is notably silent, is in the health care arena. This paper presents the case of Kaiser Permanente-Ohio and their development and use of MARS (medical automated record system); a KMS in health care.

Key words: *health care, managed care, knowledge management, knowledge management systems, knowledge workers, information systems, information technology*

1. INTRODUCTION

Knowledge management is a key approach to solve current problems such as competitiveness and need to innovate faced by businesses today. The premise for the need for knowledge management is based on a paradigm shift in the business environment where knowledge is central to organisational performance (Drucker, 1993). This macro-level paradigm shift also has significant implications upon the micro-level

processes of assimilation and implementation of knowledge management concepts and techniques (Swan et al, 1999) i.e., the knowledge management systems (KMS) that are in place.

To date, most of the recent literature that describes, discusses or critiques knowledge management systems focuses on KMS in the consulting companies such as Ernst & Young (Davenport & Prusak, 1998), KPMG (Alavi, 1999; Kanter, 1999) or at Andersen Consulting (Davenport & Prusak, 1998). This is to be expected, since the consulting companies have been some of the first to enter the knowledge management abyss (Wickramasinghe, 2000). However, by solely focussing on this segment one cannot help thinking that it is only in the consulting area where we can see KMS in practice or where KMS are of use and benefit. Furthermore, by limiting the discussion and debate to KMS prevalent in the consulting arena we are restricting our view and run the risk of under representing a wider range of KMS. In order to address this apparent void, our paper presents an example of a KMS in health care; the case of MARS at Kaiser Permanente-Ohio. We note that in the medical care field, in particular, systems such as MYCIN or EMCYIN appeared decades ago; however, they are generally discussed from the perspective of expert systems in health care rather than knowledge management systems per se; the distinction while subtle is indeed significant.

2. KNOWLEDGE MANAGEMENT

2.1. Definition of Knowledge Management

Knowledge management deals with the process of creating value from an organisation's intangible assets (Wigg, 1993). In essence then, knowledge management not only involves the production of information but also the capture of data at the source, the transmission and analysis of this data as well as the communication of information based on or derived from the data to those who can act on it (Davenport, 1999).

2.2. The Need for Knowledge Management

Sustainable competitive advantage is dependent on building and exploiting core competencies (Prahalad & Hamel, 1990). In order to sustain competitive advantage, resources which are idiosyncratic (and thus scarce), and difficult to transfer or replicate are required (Grant, 1991). A knowledge-based view of the firm identifies knowledge as the organisational asset that enables sustainable competitive advantage especially in hyper competitive environments (Alavi, 1999; Davenport & Prusak, 1998; Zack, 1999) or in environments experiencing radical discontinuous change (Malhotra, 2000). This is attributed to the fact that barriers exist regarding the transfer and replication of knowledge (Alavi, 1999); thus, making knowledge and knowledge management of strategic significance (Kanter, 1999).

Since knowledge management, addresses the generation, representation, storage, transfer and transformation of knowledge (Hedlund, 1994), the knowledge architecture, is designed to capture knowledge and thereby, enable the knowledge management processes to take place. Underlying the knowledge architecture (refer to Figure 1) is the recognition of the binary nature of knowledge; namely its objective and subjective components. Knowledge can exist as an object, in essentially two forms; explicit or factual knowledge and tacit or "know how" (Polyani 1958, 1962). It is well established that while both types of knowledge are important, tacit knowledge is more difficult to identify and thus manage (Nonaka & Takeuchi, 1995). Further, objective knowledge can be located at various levels; e.g., the individual, group or organisation (Hedlund, 1994). Of equal importance, though perhaps less well defined, knowledge also has a subjective component and can be viewed as an ongoing phenomenon, being shaped by social practices of communities (Boland & Tenkasi, 1995).

The knowledge architecture then, recognises these two different yet key aspects of knowledge and provides the blue prints for an all encompassing KMS. Clearly then, the knowledge architecture is defining a KMS that supports both objective and subjective attributes of knowledge. Thus, we have an interesting duality in

knowledge management that some have called a contradiction (Schultz, 1998) and others describe as the *loose-tight* nature of knowledge management (Malhotra, 2000).

The *loose-tight* nature of knowledge management comes to being because of the need to recognise and draw upon two distinct philosophical perspectives; namely, the Lockean/Leibnizian stream and the Hegelian/Kantian stream. We prefer to call this the Yin-Yang of knowledge management. The principle of Yin-Yang is at the very roots of Chinese thinking and is centred around the notion of polarity not to be confused with the ideas of opposition or conflict (Watts,1992). We believe this Yin-Yang metaphor is appropriate for describing these two sides of knowledge management because both are necessary in order for knowledge management to flourish.

Figure 2 depicts our Yin/Yang view of knowledge management. This figure shows that given a radical change to an environment or given a highly competitive environment an organisation needs knowledge to survive. From our Yin/Yang depiction of knowledge management we see that knowledge is required for the organisation to be effective and efficient but new knowledge and knowledge renewal is also necessary. The ultimate challenge for KMS is that they support both these components of knowledge management; loose/tight, subjective/objective perspectives. The pivotal function underlined by the knowledge architecture is the flow of knowledge. The flow of knowledge is fundamentally enabled (or not) by the knowledge management system.

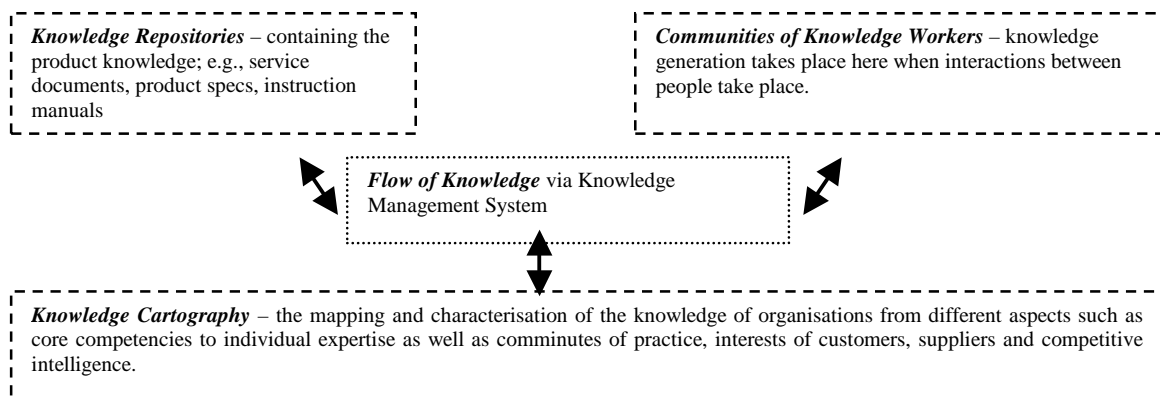


Figure 1: The Knowledge Architecture (adapted from Borghoff et al., 1998)

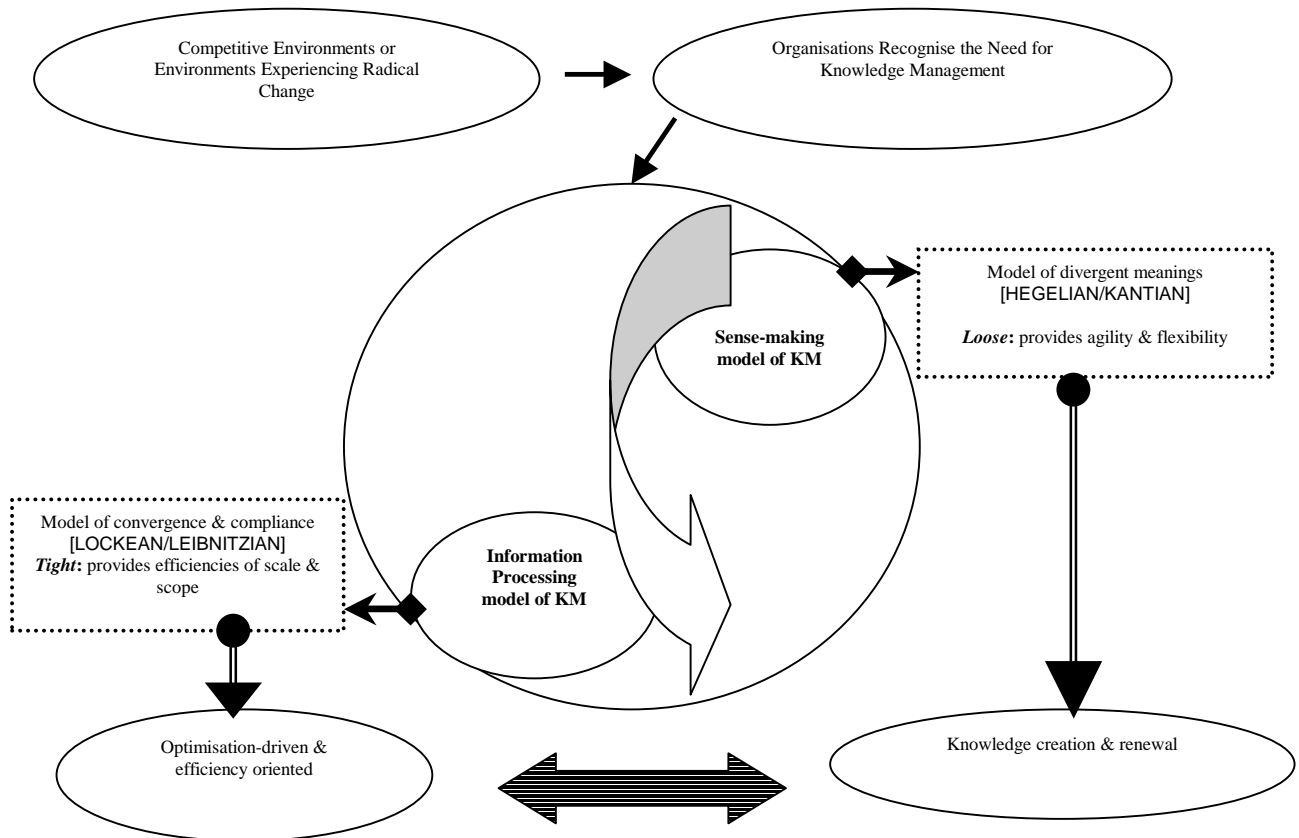


Figure 2: The Yin Yang of Knowledge Management (KM)

3. KAISER PERMANENTE’S MARS

We believe MARS is a truly unique KMS in the US health care environment. This system was designed and adopted with the goal of efficiently and effectively leveraging the collective experience and knowledge of employees in order to provide a better, quality health care experience for patients as well as to enable Kaiser to operate in the Managed Care, health care environment in the US.

The following case description represents a synthesis of information primarily obtained from semi-structured interviews together with documents gathered, passive observations and demonstrations witnessed (Wickramasinghe, 1999). In gathering the data, standard techniques for conducting qualitative case study research were followed (Yin,1994; Kavale,1996). Thematic coding and data reduction strategies were then adopted to sharpen, sort, focus and organise this data into a coherent and logical whole from which conclusions can then be drawn (Miles and Huberman, 1994; Boyatsis,1998) (An appendix that details the specific steps taken will be supplied upon email request).

3.1. Managed Care

In the U.S., the health care industry is in a state of flux (Chandra et al., 1995; Wolper 1995; Kongstvedt, 1993; Applegate et al. 1986). ‘The rate of the rise in health care costs has been variable. The shocking increases experienced in the early 1990s, has slowed in the mid-and late 1990s, but there is no guarantee that they will continue to do so’ (Kongstvedt, 1997 pp xvii). In other market places buyers are sensitive to the price of the product and thus calculate a cost-benefit analysis. ‘In the medical market place, however, the buyers and users of medical services and technologies have been relatively insensitive to the cost of these

services' ... 'The traditional financing and reimbursement policies of the health care industry are felt to be largely responsible for this price insensitivity, inhibiting the forces of competitive supply and demand economics (Applegate et al. 1986 pp. 80). Therefore, it is necessary for providers of medical care to develop ways to control and manage costs as well as increases productivity without compromising quality. As an attempt to stem the escalating costs of health care, managed care has emerged. It is aimed at creating value through competition in order to combat '...an extremely wasteful and inefficient system that has been bathed in cost-increasing incentives for over 50 years' (Enthoven, 1993, p. 40). The intended result is to provide adequate quality health care and yet minimise, or at least reduce, costs.

Managed Care Organisations (MCOs) contract with individuals, employers and other purchasers to provide comprehensive health care services to people who enrol in their health plans. The essential difference between MCOs and more traditional types of medical care is connected with the distribution of financial risk among the purchaser of health care, the provider of the care and the insurer (Knight, 1998). 'MCOs typically reduce this financial risk for the purchaser of health care insurance by guaranteeing a comprehensive range of services at a fixed price to them. To do this of course, the MCO must keep the use of health care resources within a budget; thus making critical a focus on managing medical care.' (Wickramasinghe and Silvers, 2001) This then, represents a radical change to the traditional health care environment where quality irrespective of cost was the goal. The new goal is cost effective quality care and thus, also demands a more competitive health care environment; an environment particularly suited to a knowledge management focus as depicted in Figure 2.

In managed care environments, physicians can be thought of in terms of very sophisticated knowledge workers (Wickramasinghe, 2000). Like other knowledge workers, physicians "make sense" of this wealth of knowledge (Borghoff & Pareschi, 1998), they own the means of production (i.e., their specialized knowledge), they possess specialized skills and training which they have acquired by investing significant resources towards their education, and they make decisions that have far reaching consequences both for their organizations and their patients (Wickramasinghe, 2000).

For the MCO, cost effectiveness and quality treatment are critical goals. The physician plays a tremendously important function in determining both the quality and cost of the care rendered. The MCO contracts with and relies upon its physicians to achieve its dual (and often conflicting) goals of cost effectiveness and quality health care. Both the objective focus of knowledge management; i.e., the focus on efficiencies and effectiveness of health care treatment and the subjective focus of knowledge management; i.e., the emphasis on communities of knowledge workers or physicians and their ability to create new knowledge pertaining to health care treatment become very important in this setting. Furthermore, this is the ideal opportunity for a MCO to implement a KMS.

3.2. Kaiser Permanente

Kaiser Permanente is one such MCO operating in this radically changed managed care, health care environment. Kaiser represents an atypical structure in the US health care environment. The structure of this organisation is connected closely to its long history.

3.2.1. History

Kaiser has national coverage across various parts of the US. It is a nonprofit, closed staff group practice prepayment plan providing comprehensive medical and hospital services to more than 6.6 million enrolled members in 8 geographic regions and 10 states plus the district of Columbia. It began in the west and was opened to public enrolment in 1945, thus making it one of the first MCOs in the U.S. Today, Kaiser nationally, has about 11,000 full time physicians representing all specialties; 57% of these are primary care physicians (Physicians). In addition, it employs about 75,000 non-physician health care professionals and administrative, clerical and technical employees. Nationally, Kaiser has 35 hospitals, with more than 7,397 licensed hospital beds and over 400 medical office locations for outpatient services.

The Ohio organisation of Kaiser¹, which is the focus of our paper, began in 1964. It now has around 180,000 members, 12 ambulatory care locations, over 200 physicians and over 100 allied health professionals. Kaiser, both in Ohio and nationally, throughout its history has attempted to combine the strengths of medical and business professionals in an equal partnership for the maintenance of an efficient and cost-effective health care delivery system.

3.2.2. Structure

The unique structure of Kaiser is depicted in Figure 3. The three separate, yet closely co-operating organisational structures of MCO, Hospitals/facilities and Group Practice is typical of each of Kaiser’s 8 regions across the U.S. From Figure 3, it can be seen that members enrol in health plans with Kaiser. In turn, these members are treated by a closed group practice of doctors (the Permanente physicians) at Kaiser hospitals/facilities. These Permanente physicians do have ownership interests in Kaiser and work only for Kaiser. Kaiser owns its own ambulatory or out patient care facilities and has contracting arrangements with major hospitals. Where the closed group practice of doctors does not cover certain services and /or geographic areas, then Kaiser contracts out both specialty care and primary care services. This only occurs in a very small percentage of situations (1% of Kaiser’s physicians are network physicians). From the member (patient) perspective however, this structure appears as one organisation – Kaiser Foundation Health Plan, Permanente Medical Group physicians and Kaiser’s facilities.

This figure depicts the organisational structure for Kaiser:

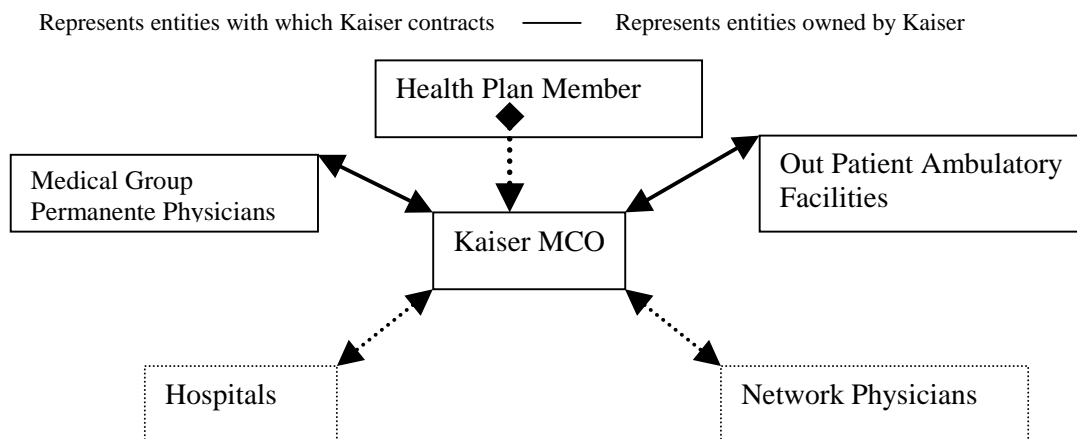


Figure 3: Structure of Kaiser

3.2.3. Administrative Issues for Kaiser

The administrative issues for this case are all connected with ensuring that a member has an appropriate quality of service through the system and that the goals of appropriate, cost-effective health care ensue. To help facilitate appropriate treatment, each member is assigned to a primary care physician (PCP) and this physician is held accountable for the member’s activities. Such a PCP as a gatekeeper model is typical in a managed care environment (Wickramasinghe and Silvers, 2001).

Another critical administrative issue is concerned with the generating of reports. Reports are required for employer groups, regulatory bodies and for the adjusted community rate for the pre-paid plans. Further, several groups want to be self-funded which requires internal services to generate various bills. Kaiser is looking to an IS/IT solution to enable better report generation. At present, generating some of these reports is

¹ The term KAISER is used throughout to refer to the Ohio division of the MCO unless otherwise stated.

tedious and often the data recorded is inaccurate. The Manager of Operations explained this issue in the following manner.

“In the past, this has not been an issue, but now employers and regulations require detailed information and justification for costs. Our docs, since they have not done this in the past, are a bit sloppy and inaccuracies or not detailed enough information can result. I believe IS can play a great role in helping us with this problem and currently we are looking into it.” [Manager Operations]

3.2.4. Clinical Issues for Kaiser

The primary concern for the physician is the care of the patient. This was acknowledged by all the physicians interviewed and reflected in the following comment.

“I am first concerned, yes it is perhaps selfish, with whether I can do a good job for the patient and give him(her) good care; and that he(she) feels I am a good doctor.” [Physician]

The physicians' focus on health care as their chief goal. Further, they believe that by doing this everything else will follow naturally. If physicians are 20% non-compliant; i.e., if physicians do not adhere to reminders/recommendations regarding treatment practices more than 20% of the time, they will receive a letter telling them so and that it is necessary for them to address this matter. If non-compliance continues there may be financial repercussions. In addition, there is a random per month review.

In summary then, within its unique structure of Kaiser MCO, Kaiser Physicians and Kaiser facilities, Kaiser must deliver cost effective, quality health care to its members as well as address the key administrative and clinical issues. To do this, Kaiser relies heavily on its IS/IT (Information Systems/Information Technology), in particular MARS (medical automated record system).

3.2.5. MARS

The several systems that are prevalent in this environment fall into the following two main categories: 1) Clinical systems and 2) Business systems. The former includes systems that handle appointment scheduling, encounter visit data, lab and radiology, document management (which stores images of treatment records and other clinical forms), internal referral, and clinical messaging. The business systems handle membership / benefits, claims, referrals and patient accounting. The most important system for Kaiser is MARS. MARS is the product of several integrated systems running on two distinct operating environments and supports and enables both clinical and business (administration) needs. The various application systems that comprise MARS are briefly discussed in Table 1.

3.3.1. Systems Architecture

There are two major IS environments for Kaiser; 1) The Mainframe environment and 2) The Client/Server environment. The Mainframe environment consists of a large mainframe using the MVS operating system. The applications run in a CICS environment and use IDMS, DB2 and VSAM to store their information. The telecommunications network is an SNA network communicating through T1 lines to 14 facilities. This network supports 3270 devices numbering in the thousands. The Client/Server environment is used to support the Imaging application and consists of multiple servers running Microsoft NT Server. Fourteen Local Area Networks(LANs) are used to link workstations to the servers. These LANs are connected via Frame Relay circuits to make up the Wide Area Network (WAN). TCP/IP is the networking protocol used to send data between the various computers.

3.3.2. The Role & Impact of MARS

MARS is pervasive throughout all the facilities Kaiser is associated with in Ohio. Further, it is not possible for physicians to care for patients without using this system². The major reason for this system is to support delivery of quality health care in a cost-effective manner. MARS is a very sophisticated system in the current health care market. The standards the system uses are based on NCQA (National Committee for Quality Assurance) standards and data this MCO has gathered; i.e., findings from key Medical journals such as The New England Journal of Medicine or Journal of American Medicine, as well as data generated and analysed from Kaiser’s own data base of patient history. These standards are continually updated and revised as new findings become available.

MARS not only enables the physicians to perform their work more effectively and efficiently, as well as render high quality services to their patients, but also provides them with care parameters. MARS helps to enforce practice guidelines, in addition it provides peer data on providers which enables benchmarking for specific treatments in terms of costs, length of stay and other key variables to be calculated. MARS also enables Kaiser to understand the occurrence of outliers; i.e., physicians’ practice patterns can be studied to understand why they are outliers and then it is possible, if necessary, to change inappropriate behaviour and thereby support effective and efficient delivery of health care. Physicians play an active role with defining the criteria and characteristics of the monitoring function. This is an example of a knowledge creating/renewal aspect supported by MARS, as the interview extract below highlights.

Components of the MARS	Function
The Encounter System	This system is used to collect and process information related to outpatient visits. It also collects information at time of visit, in order to maintain a longitudinal patient history. In addition, the system presents and collects information related to various tracking mechanisms. This system provides a variety of on-line tools for gathering clinical information. Most of these tools are “patient-centric” like the traditional medical record. The database is designed to give maximum performance to inquiries being made at the patient and encounter levels.
Sunquest Lab Information System	Used for collecting and tracking orders and furnishing results of lab tests
Radiology Information System	Internally developed and is used to place, track and furnish results of radiology exams.
ACUMEN	Graphical user interface application that allows the health care provider to review clinical information related to a patient in a “point and click” fashion
MedSTAR	Document processing system used in MARS to capture all paper-based forms of information
Order Entry	Designed to be a central point for placing clinical orders, tracking them and providing results in a timely fashion
ACUXFER	Used to validate information received electronically from the external systems for which no other validation process exists

Table 1: Systems Making Up MARS

² It is noted that some of the network physicians do see patients without this system but this is a very small percent.

“I was involved with developing criteria and recommendations for the cardiac related reminders in the system. We spent lots of time deciding how best to go about the development of the heart recommendations; e.g., use of lipid reducing agents to lower cholesterol and giving aspirin and beta blockers.” [Specialist]

The following are examples of comments made by physicians highlighting the essential features of MARS. Further, these attributes were the reasons all these physicians identified as to why the system enhanced their work; i.e., impacted on enhancing effectiveness and efficiencies.

“The system will remind me if a patient requires a mammogram or if aspirin should be prescribed.” [Physician]

“Benefits of the system are it is possible to get lab and radiology information straight away also no paper charts everything is there at once; i.e., all the patient’s history. Thus, when a patient calls, I can immediately answer questions as I have all information available and I can remember the details of the case very quickly.” [Physician]

One key feature of MARS is a computer generated reminder program. Among the 50+ reminders is one to reduce cardiac morbidity and mortality. Specifically, the program uses computer-generated reminders to improve physician compliance with published guidelines for cardiac disease. These guidelines have been agreed on by both the Physician Group and Kaiser as appropriate practice guidelines with which physicians should comply and are critical to the delivery of cost effective quality of health care.

4. MARS AS A KMS

Technologically speaking, MARS consists of technologies consistent with KMS in practice such as those in the consulting arena as well as those discussed in theory. In particular, MARS consists of client/server technology, relational databases, intranet and extranet capabilities. We now highlight the features of MARS that support at least one or both arms of knowledge management; i.e., the subjective and objective components (refer to Figure 2).

4.1. Objective Elements of Knowledge Management Supported by MARS

Kaiser is highly dependent on IS/IT (information systems/information technology) generally and MARS in particular. This finding is based on interview data, as well as observations of the system and documents detailing and describing the system. In fact, if MARS were removed, the organisation could not perform its daily activities; Kaiser would no longer be able to gather data about utilisation levels or physician behaviour regarding adherence to pre-determined treatment recommendations; e.g., giving aspirin to patients with certain heart conditions nor would it have the ability to easily access patients medical records throughout its system. The benefits of the system as they pertain to enabling and enhancing information processing are significant. Certainly the objective aspects of knowledge management are clearly being satisfied through MARS. The following interview examples serve to illustrate this key finding.

“A rough cost savings can be seen from the following: by having the MARS we save on Medical Record Room and Support Staff \$2,800,000, Generation of Clinical Forms \$500,000, and Generation of Billing Data \$ 400,000 – a total of \$3,700,000/Year. The expenses for the system include the following: Personnel \$600,000, Printing \$200,000, Network Expenses \$150,000, Memory \$ 70,000, and License renewals \$80,000 – a total of \$1,100,000/Year. Thus you can see that this saves us \$2,600,000/Year. These are only the benefits regarding reduction in administrative or operating costs. On top of this, we avoid costs of treatments that would otherwise be necessary if preventative measures had not been taken. Then there are also the benefits that are less easy to quantify such as better care for the patient, the ability to see more patients, the ability to generate important information and having this information in a form that can easily be analysed.” [Associate Medical Director]

“If you just look at the reminder program for aspirin there is approximately a 90% compliance among all our physicians. We thus reduce morbidity, and also decrease many instances where costly heart or heart related procedures would have otherwise been required. So we meet our goals of improving quality, reducing organisational expense and producing a data stream for electronic billing.” [Specialist IS Person]

This comment can be confirmed by examining data that shows changes in mortality rates such as the following:

1993 death rate for Coronary artery disease (per 1000 members/ year): 1.22

1995 death rate for Coronary artery disease (per 1000 members/ year): 1.17

“One of the drivers for MARS was quality of care. We have certainly achieved this. Further, the system enables us to monitor our physicians so we can see in a timely and efficient fashion that the standard of care is uniform and compliance is being achieved. In today’s health care environment, cost consciousness is also crucial and this system has helped us concerning this aspect as well.” [IS Manager]

Clearly then, MARS is supporting the optimisation-driven and efficiency oriented aspects of knowledge management as outlined by an information processing model of knowledge management (Refer to Figure 2). This is indeed a critical aspect for Kaiser given the managed care environment in which it must operate.

4.2. Subjective Elements of Knowledge Management Supported by MARS

We have already presented some testimonies from physicians regarding their usage of and interaction with MARS. All physicians interviewed endorsed that the system helps them perform their work more effectively and efficiently. Further, the system enables them to render better quality of service to their patients. These physicians all found the reminders (for example for use of aspirin) as helpful.

MARS however, also enables and facilitates other activities amongst the physicians and other members throughout Kaiser to occur. In particular, the system facilitates and encourages significant collaboration to occur; i.e., the physicians are involved in setting utilisation levels and preferred treatment methods. For example, groups of physicians and IT members have been deciding on key issues relating to tracking vaccinations and immunisation history to ensure members are inoculated appropriate to disease burden and age. Another example of continuous discussion and updating of the knowledge base of MARS can be seen with reminders/alerts for cardiac care, which are provided by the system. When newer data is available either from published medical research or techniques developed by the physicians within Kaiser become available, they are, when appropriate and with the approval of the medical group, added to the system. This sharing of knowledge, enabling discourse and discussion between physicians and other members such as the IT group within Kaiser; i.e., the performing of “sense making activities”, is enabled and facilitated by MARS.

MARS enables Kaiser physicians to continually review their own performance as well as that of their peers to try and develop better protocols and practice methods; in short knowledge renewal and creation is occurring. Hence, MARS is also supporting the subjective aspects of knowledge management.

Therefore, MARS by facilitating the activities of the knowledge workers within Kaiser actualises the knowledge management architecture for this organisation and supports both the subjective and objective components of knowledge management. It is indeed a vital KMS for Kaiser.

5. CONCLUSIONS

We set out to present a case study of a KMS that is not in the consulting field. We draw upon theory to argue that KMS should support both the subjective and objective aspects of knowledge. Frequently it is noted by researchers studying KMS in practice that these systems ignore the people factor (Swan et al , 1999) or do not support the subjective aspect of knowledge management (Wickramasinghe, 2000). We believe that

MARS is a truly unique KMS since it does support both the subjective and objective aspects of knowledge management. Specifically, MARS supports effective and efficient operations of medical care treatment at Kaiser as well as enabling and facilitating the generation of new knowledge pertaining to treatment protocols and enabling its knowledge workers i.e., Kaiser physicians to share and exchange knowledge. We believe this is a truly unique example of a KMS and more KMS in practice should follow this model; namely support both the objective and subjective aspects of knowledge management. In describing knowledge management we use the metaphor of Yin/Yang to describe the two components of knowledge management. The key to the relationship between Yin and Yang is called “hsiang sheng”, a mutual arising and inseparability (Watts, 1992). By grasping this perspective for knowledge management we see that a KMS that supports both subjective and objective aspects of knowledge management then, is a truly powerful KMS and a faithful actualisation of KMS as outlined in theory.

REFERENCES

- Alavi, M 1999 “Managing Organisational Knowledge”, Working Paper.
- Applegate, L., R. Mason & D. Thorpe. 1986. Design of a Management Support System for Hospital Strategic Planning, *Journal of Medical Systems*, vol. 10, no 1, pp. 79- 94.
- Beckman, T 1999. “The Current state of Knowledge Management” in J.Liebowitz Ed *Knowledge Management Handbook*, 1999CRC Press, New York.
- Boland, R & R. Tenkasi 1995 “Perspective Making Perspective Taking, *Organisation Science*, vol 6 pp.350-372.
- Borghoff, U & R. Pareschi 1998 *Information Technology for Knowledge Management*, Springer-Verlag, Berlin.
- Boyatzis, R. 1998. *Transforming Qualitative Information Thematic analysis And Code Development*, Sage Publications, Thousand Oaks.
- Chandra, R., M. Knickrehm & A. Miller. 1995. Health Care’s IT Mistake, *The McKinsey Quarterly*, Number 5.
- Davenport, T & L. Prusak, 1998 *Working Knowledge*, Harvard Business School Press, Boston.
- Drucker, P. 1999. Beyond the Information Revolution *The Atlantic Monthly*, Oct pp. 47-57.
- Drucker, P. 1993. *Post-Capitalist Society*. New York, Harper Collins.
- Enthoven, A. 1993. The History and Principles of Managed Competition, *Health Affairs*, pp. 25-48.
- Evans, P. & T. Wurster 2000 *Blown to Bits How the New Economics of Information transforms Strategy*, Harvard Business School Press, Boston.
- Hedlund, G “ A Model of Knowledge Management and the N-Form Corporation”, *strategic Management Journal*, vol 15 pp.73-90.
- Hope, J. & T. Hope 1997 *Competing in the third wave*, Harvard Business School Press, Boston.
- Huber, G. 1990. A Theory of the Effects of Advanced Information Technologies on Organisational Design, Intelligence, and Decision Making, *Academy of Management Review*, vol. 15. no. 1, pp. 47-71.
- Kanter, J 1999. “Knowledge Management Practically Speaking” *Information Systems Management*, Fall.
- Kavale, S. 1996. *Interviews An Introduction to Qualitative Research Interviewing*, Sage, Thousand Oaks.
- Knight, W. 1998 *Managed Care: What It Is and How It Works*, AspenPublication, Maryland
- Kongstvedt, P. 1997. *The Managed Health Care Handbook*. Aspen Publication, Maryland.
- Kongstvedt, P. 1993. *The Managed Health Care Handbook*. Aspen Publication, Maryland.

- Malhotra, Y. 2000 "Knowledge Management & New Organisational Forms" in Knowledge Management and Virtual Organisations Ed. Malhotra, Y. Idea Group Publishing, Hershey.
- Miles, M & A. Huberman 1994. *Qualitative Data Analysis: An Expanded Source Book*, London, Sage
- Nonaka, I 1994. "A Dynamic Theory of Organisational Knowledge Creation", *Organisation Science*, vol. 5 pp. 14-37.
- Prahalad, C & G. Hammel 1990 "The Core Competence of the Corporation" *Harvard Business Review* (68) pp. 79-90.
- Polyani, M. 1958 *Personal Knowledge: Towards a Post-Critical Philosophy* The University Press Chicago, Chicago.
- Polyani, M. 1966 *The Tacit Dimension* Routledge & Kegan Paul, London.
- Swan, J., H. Scarbrough & J. Preston 1999 "Knowledge Management – The Next Fad To Forget People?" *Proceedings of the 7th European Conference in Information Systems*.
- Schultz, U. 1998 "Investigating the Contradictions in Knowledge Management" presentation at IFIP Dec.
- Shapiro, C & H. Verian 1999 *Information Rules*, Harvard Business School Press, Boston.
- Watts, A. 1992 *Tao the Watercourse Way* Arkana London.
- Wickramasinghe, N & J.B. Silvers 2001 *IS/IT: Enabling Medical Group Practices In A Managed Care Environment* forthcoming in 34th HICSS proceedings Jan.
- Wickramasinghe, N 2000 *The Triumverate business system for the 21st Century* in Hackney, R & D. Dunn Eds. *E-Knowledge*, MacMillan, London.
- Wickramasinghe, N 1999. *Knowledge Management Systems: The Hidden and The Manifest*, Grant Proposal submitted to The Faculty of Economics & Commerce, The University of Melbourne
- Wickramasinghe, N. 2000 *IS/IT As A Tool To Achieve Goal Alignment In The Health Care Industry* *Int. J Healthcare Technology and Management*, Vol. 2 No. 1/2/3/4, pp. 163-180.
- Wickramasinghe, N. 1999. IS/IT As A Tool To Achieve Goal Alignment In The Context Of The Knowledge Worker In The Health Care Industry, Ph.D. Dissertation, Case Western Reserve University.*
- Wigg, K 1993 *Knowledge Management Foundations*, Schema Press, Arlington.
- Wolper, L. 1995. *Health Care Administration*, Aspen Publication, Maryland .
- Yin, R. 1994. *Case Study Research : Design and Methods* 2nd Edition, Sage Publications, Newbury Park.
- Zack, M 1999 *Knowledge and Strategy*, Butterworth Heinemann, Boston.