Understanding and selecting knowledge management systems for a health information provider

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Abstract
In the current market there is a proliferation of knowledge management software solutions. The aim of this paper is to discuss issues concerned in selecting such a system to support knowledge workers. Soft Systems Methodology (SSM) and SISTeM (Cycle 1) were used as problem solving approaches within an action research framework to analyse KMS issues, human computer interaction, and developing criteria for selecting a system. Selection criteria for knowledge management systems are then outlined and applied to a case study in evidence based health care.

1. Introduction
Knowledge management (KM) has been a buzzword in a range of subject disciplines for many years, and has latterly been applied to health care, and those knowledge workers within this environment. [1, 2] With the growth of this concept, there has also been a need to develop ways of understanding knowledge processes within this context and to select knowledge management systems that can help in knowledge creation, storage and sharing.

Over the past few years there has been a rapid growth of technologies that their vendors characterize as knowledge management software.... It is fair to say that no single product offering satisfies all of the organization’s KM needs. [3]

Knowledge management systems (KMS) are tools to effect the management of knowledge and are manifested in a variety of implementations. Alavi and Leidner describe these as,

"Target(ing) professional and managerial activities by focusing on creating, gathering organizing and disseminating an organization’s ‘knowledge’ as opposed to ‘information’ or ‘data’”[4]

To gain a wider understanding of what is required when selecting a KMS, it is important to develop an appreciation of the conduct of KM in an organization, including current practices and desired practice. Second, an awareness of KM technologies is valuable [3] This paper aims to give a broad overview of many of the issues that need to be addressed when looking for KMS, rather than a in-depth analysis of issues such as interface and usability of such systems. It also aims to develop broad criteria that can be used when selecting knowledge management systems.

2. Case Study
Knowledge management within the context of evidence based health care gives the potential to improve quality of service provided to practitioners seeking such evidence. Knowledge workers operate in this environment invited the researcher to work with them within a large teaching hospital in Melbourne, Australia. [5] This complicated knowledge rich community of practice has been used to illustrate the complexities of selecting knowledge management systems.

This specialist evidence centre was set up, funded by the state government, to provide information about clinical effectiveness to all health practitioners within a wide geographical area covering four hospitals and a range of community health centres. The service has been running for over two years, and answers enquiries from medics, professions allied to medicine, nurses and midwives. These range in difficulty and complexity, depending on the questions and especially on the types of evidence which can be found and used to answer the question asked.
An example of such work, is the question posed to the service by an infection control manager, ‘is standard precautions effective in preventing the transmission of blood borne viruses (HIV, HBV, HCV) in haemodialysis unit setting? What preventative measures have been effective?’ [6]

Systematic reviews, evidence-based guidelines, health technology assessments and randomised-controlled trials from databases were searched to help answer this question. From such searching, it was found that there was little ‘gold standard’ evidence in the form of systematic reviews of randomised controlled trials, so that other types of evidence were taken into consideration in answering this question.[7] From the moment the question is asked, knowledge is generated through the interpretation of the question, selecting appropriate information to answer the question, appraising the evidence for its rigour and validity and translating it into relevant, understandable knowledge that the practitioner can use.

3. Methodology

Action research was selected as a research framework for this study. It can be defined as

“a cognitive process that depends on social interaction between the observers and those in their surroundings” (p. 91)[8]

The format of action research used within this research is that described by Susman and Everard, with five phases including diagnosing, action planning, action taking, evaluating and specifying learning. [9] What follows is a description of the phases that moved the researcher and participants closer to their goal of selecting a KMS.

Within action research there are a range of problem solving approaches used in the investigation of information systems. [10] One such approach is Soft Systems Methodology (SSM); this can be used as a method that explores the notion of ‘purposeful human activity’. [11] SSM not only enhances our knowledge of the problem and situation but also comes up with a useful intervention for such situations. The action research tradition recognises that the priority is one of reaching practical solutions to the problem at hand instead of only testing and generating theory. [12] Checkland’s SSM lies firmly within the tradition of action research which ‘aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework’ (Rapport, 1970)

4. Diagnosing

By using SSM the researcher and participants were able to diagnose what was taking place within the community of practice. Through interviews, focus groups and participant observation, the concepts of knowledge management where discussed. A range of knowledge management activities were taking place, the main question raised from this activity was ‘how can we choose technology (KMS) to improve the work situation?’ They identified the following issues:

- Knowledge generated during this encounter may be lost and not stored or not shared by this or other knowledge workers in future encounters
- Participants had a will to fix things but did not know how to go about it
- Participants were IT literate but could not articulate knowledge management processes to move them toward thinking about a KMS
- With a proliferation of products on the markets, they felt the selection process would be like ‘comparing apples with oranges’

All of these issues created a realisation that the application of KMS could help alleviate many of these problems but there was some way to go between having this realisation and implementing a KMS.

5. Action Planning

Information technology can help to structure knowledge and represent explicit knowledge; there are a range of technologies available that support this work. From a knowledge systems perspective such technologies are outlined in Table 1 by Skryme. [13]
From this list, it can be seen that there are a host of possibilities facing the community of practice, when looking at technology to help them solve some of their knowledge management problems. Unfortunately, for many organisations, such as those within the case study, they have limited knowledge outside their core competencies in order to make the appropriate decisions about KMS.

While it was useful to use SSM in diagnosing KMS needs, it did not help participants or the researcher at the stage of thinking about using information technology and therefore concentrating on human-machine activities. To help with this phase of the project Soft Information Systems and Technologies Methodology (SISTeM) was used. [14, 15] This provides a more practical approach to promote “operational decision making and bringing about the integration of organisational, information and technological changes within the situation” [16]

Table 1 Knowledge management technologies [13]

<table>
<thead>
<tr>
<th>Knowledge based inputs</th>
<th>Extracting hidden information</th>
<th>Filtering according to profiles</th>
<th>User oriented presentation</th>
<th>Condensing information</th>
<th>Intelligent agents</th>
<th>Email filters</th>
<th>Relevance ranked searches</th>
<th>Concepts retrieval</th>
<th>Visual maps</th>
<th>Data and text mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge process</td>
<td>Retrieves old evidence reports</td>
<td>Rules and induction</td>
<td>More rapid combinations</td>
<td>Case based reasoning</td>
<td>Experts systems</td>
<td>Email filters</td>
<td>Workflows</td>
<td>Push technology</td>
<td>Intelligent agents</td>
<td></td>
</tr>
<tr>
<td>Knowledge repository</td>
<td>Holds most current information</td>
<td>Single point of reference</td>
<td></td>
<td>Thesaurus management</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Knowledge flows</td>
<td>Timely routing</td>
<td>Improving workflow</td>
<td>Alerting users to change</td>
<td>Emails</td>
<td>Workflow software</td>
<td>‘Push’ technology</td>
<td>Intelligent agents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge outputs</td>
<td>Supports thinking processes</td>
<td>Informing decision making</td>
<td></td>
<td>Cognitive tools</td>
<td>Idea generation</td>
<td>Visual mapping</td>
<td>Decision support:</td>
<td>meeting support</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SISTeM is used within the rest of the action research phases to help identify KMS selection criteria. This approach has also been used within a variety health care settings by the developer of SISTeM and so is relevant to the case study in this paper. The methodology contains two cycles, the first focuses on strategic decision making and broad principles, and the second cycle covers operational issues, with decisions for action and processes for decision making.

Using this methodology was a way to articulate what was needed from a KMS in order to aid action planning. The phases of this action research cycle describes part of this process rather than describing the whole methodology, and as with SSM has been used as a problem solving approach. The emphasis is on Cycle 1 of the methodology, at strategic level, which is where decisions of principle were used to guide decision making in KMS before practical decisions for action were made.

Cycle 1 began with an analysis of the problem situation and moved to a decision, which would lead to change and the new problem situation being explored through Cycle 2. Exploring the situation at hand provided a focus on Information Systems described by Atkinson [16] in this community of practice, current and future, but also the impact that these have on how knowledge workers do their job. A political and social analysis also helped to explore the role that IT staff had to play within the case study, and the experiences and attitudes to KMS and IT by potential users of a system.

6. Action Taking

Existing systems and technologies were identified through discussion and debate with participants, and are used as the basis of decision making further on in Cycle 1 of SISTeM. The organisation already had in place a range of knowledge repositories that could be exploited and compiled into a knowledge management system. These included:

- Document databases: evidence reports, minutes of meetings, proposals
- The Internet: their own work on their own web site; the web sites of other organisations who provide evidence on effective practice
- External databases: those that are searched, for example the Cochrane database, Medline, CINAHL, and others
• Less formalised databases of user feedback
• Local network server for storage of internal documents

From this understanding of what was currently available and utilised, participants and the researcher could then define what the system needed to cover.

6.1 Root Definitions and Conceptual Models
During Cycle 1 human machine systems that relate to knowledge management issues and tasks were identified. A root definition and CATWOE, as described in Soft Systems Methodology [17] were drawn from past work by the author, [18] the human activity system had been defined so that articulating the human machine activity was a simple process.

Root Definition
*A Centre owned knowledge management system operated by Centre staff and owned by the Institute that enables knowledge creation, storage and sharing*

**CATWOE**
**Customers:** knowledge workers at the Centre
**Actors:** IT staff, knowledge workers
**Transformation:** knowledge at the Centre transformed into knowledge system components
**Weltanschauung:** Knowledge creation, storage and sharing are necessary for effective knowledge management
**Owners:** Knowledge management facilitator, IT staff
**Environment:** Knowledge workers, IT staff

Having identified the system, participants worked together to develop an expressive system model linked to the root definition. This model consists of both human and machine activities; Figure 1 shows such a system model. This also took into consideration literature in the area of KMS development [19], where a wide variety of knowledge management processes have also been described. [20] This was an excellent way to identify which activities within the system needed to be supported using IT and which ones did not.

Figure 1 Expressive model of the community’s KMS

There are also tasks within the organisation that were identified as problematic. They were tasks that could be improved using IT, but would also require organisational and cultural changes. Table 2 expands on knowledge management activities and links them to KMS sub-activities. Such activities have been explored in conversations with participants and observation of their knowledge work.
### Table 2 Expressive model incorporating machine knowledge components

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RECEIVE question from user, following completion of request form</td>
</tr>
<tr>
<td>2.</td>
<td>NOTIFY group that request has arrived</td>
</tr>
<tr>
<td>3.</td>
<td>ACCRUE information about requests (who, what, when) on a weekly basis</td>
</tr>
<tr>
<td>4.</td>
<td>ALLOCATE requests to knowledge workers according to expertise, urgency, and workload</td>
</tr>
<tr>
<td>5.</td>
<td>SCOPE each question to ascertain amount of information available &amp; whether question can be answered</td>
</tr>
<tr>
<td>6.</td>
<td>REVIEW question with users, refine if necessary</td>
</tr>
<tr>
<td>7.</td>
<td>CREATE an overview of knowledge work activity to understand work in progress and workload</td>
</tr>
<tr>
<td>8.</td>
<td>SEARCH databases, WWW, grey literature if needed</td>
</tr>
<tr>
<td>9.</td>
<td>LOG methods and sources used, not used (rationale if considered useful)</td>
</tr>
<tr>
<td>10.</td>
<td>RETRIEVE hard copies of source material where necessary</td>
</tr>
<tr>
<td>11.</td>
<td>GENERATE inter library loans</td>
</tr>
<tr>
<td>12.</td>
<td>APPRAISE evidence against criteria</td>
</tr>
<tr>
<td>13.</td>
<td>WRITE report</td>
</tr>
<tr>
<td>14.</td>
<td>STORE all types of reports in a format useful for collaboration</td>
</tr>
<tr>
<td>15.</td>
<td>SEND report to user</td>
</tr>
<tr>
<td>16.</td>
<td>GAIN feedback on usability and relevance of report</td>
</tr>
<tr>
<td>17.</td>
<td>DISTRIBUTE feedback to knowledge workers, SHARE with researchers for evaluation</td>
</tr>
</tbody>
</table>

### 6.2 Debating the model

A debate about what was articulated then took place, including knowledge workers and IT staff outside the Centre being studied. This was a way of taking what KMS & IT already existed, combining them with new components needed to create a more efficient and integrated system. Such debate has brought social, organisational and political issues to the fore. While this was at times emotive and contentious, some tangible outcomes were reached, including decisions on functionality and current IT infrastructure.

At a pragmatic level, implementing a KMS could help knowledge workers capture and store knowledge about their searching and appraising the evidence as they went. This was a range of knowledge, including knowledge about what is ‘best practice’, but also, metaknowledge, knowledge about how to find the evidence. This could be in the form of what web sites to search, grey literature, and even which web sites not to go to. Many of the debates are continuing, so that achieving a ‘robust accommodation’ between competing actors and stakeholders will need to take place, so that decisions of principle can help this project move on to Cycle 2 of SISTeM.

### 6.3 The Emergent Knowledge Management System

From modelling the KMS we have been able to articulate the functionality of the systems. This has been combined with the KMS literature to create clear and realistic criteria that can be applied to systems on the market. There are however, a plethora of KMS providers in the market place, with some estimating the market in applications will exceed US$1billion worldwide by 2002. [21] A range of sources have surveyed the industry have come up with over 65 vendors [22] and Web searches by the researcher have revealed over 300 vendor and the number is growing yearly.

The language of marketing and purchasing such products is a long way from those working in health care, systems selection is outside the core competencies for such professionals and the market place is a confusing and somewhat crowded place. Linking the functionality with KM processes in one place is a pragmatic way of representing both issues and IT applications in one place for participants to gain an understanding of how they can be linked together and applications that may be possible for the community of practice to use.
It is hoped that developing some understanding of functionality of KMS will help buyers in the market make some sense of their systems needs and facilitate selection of products in such a large market place.

7. Evaluating
7.1 Social Analysis: Roles, Values and Norms
Within the case study there were underlying social issues that were important when thinking about applying KMS, these are the roles, values and norms of the knowledge workers that will have an impact on the development and implementation of any solution that is arrived at.

Roles: to carry out a range of activities supporting evidence based health care within Hospital to improve decision making and the quality of health care
Norms: differ for the range of clinical and professional groups represented in this team, such norms when applied to evidence based health care also differ depending on background and training in the area.
Values: intrinsically formed within the group. As the group contains doctors, nurses, information people, and researchers from health care and the academic sector, some of these norms will be brought into the group
Knowledge management and technology: knowledge management was new to participants, so that they may be unable to articulate what was needed as far as a KMS was concerned. All have extensive but varied experience in using a range of IT applications and are comfortable with new applications

7.2 Political analysis
Paradigms in evidence based health care differ between the clinical professions, with medicine having a fairly narrow focus in acknowledging what the ‘gold’ standard of evidence is. [7] In the case of the participants discussed, the focus is on systematic reviews and randomized controlled trials. This is reflected in the philosophy and focus of knowledge delivery that is provided by this centre. This however, may be at odds with the needs of the users, who would like a range of sources of evidence, and thus impedes a broad range of knowledge about clinical practice being stored.

In relation to knowledge management and systems to support such work, knowledge can become a commodity for power, developing exclusive roles and an over reliance on particular members of the group for their skills and knowledge. Vocal members of the group can also influence the interpretation of what knowledge is important and therefore what should be stored and shared within the group.

The experiences of information technology so far have been varied. Most workers have the hardware and software that they need to do their job, but may be restricted to ways of working by the parent organisation. They also have the added conflict of working within a health care organisation but also belonging to a university department. In this case it can be said that they have ‘two masters’ as far as IT was concerned, that of the distant university that set policy and licensed products, and also local IT support and expertise. The politics of such a scenario makes it difficult for the community of practice within the case study to be autonomous as far as IT was concerned and dependent on vocal influences within the parent organisation to make decisions for them. An example of this is the setting up a local server, this took considerable time to purchase and implement because of the aforementioned problems. Discussion is now raging about the use of the shared drive as an unrestricted storage device compared to a knowledge repository where control of content and codification need to be addressed.

8. Specifying Learning
Learning took place throughout this action research cycle, but can be summarised in this section. For participants who are not used to thinking about knowledge management processes this project was something new. By doing this they learned what was happening within their own community of practice and made suggestions for how things could be improved, this lead to feelings of ownership and support for new systems. IT staff within the case study were happy to collaborate with this project, but sometimes felt they had limited autonomy in influencing decision making when it came to the wider organisation. Knowledge gained throughout the process was used to influence the parent organisation to improve procurement and support systems to improve local working. At a conceptual level the project will provide a new range of knowledge in relation to intermediaries and knowledge management within health care.
‘Double loop learning’ as described by Argyris and Schon [23], looks at restructuring organisational norms to reflect new knowledge gained during the research. This happened by participants articulating KMS needs which in turn raised an awareness of how and why current systems were used. It also challenged the wider organisational decision making processes, and was often viewed as an uncomfortable challenge to the status quo. Participants enjoyed the experience of analysing the political and social side of their work, something that was new and at times controversial. The researcher learned that developing selection criteria and linking it to KM process was much more difficult than the literature or those working in the field had suggested.

9. Conclusion
From an analysis of the knowledge management environment studied, many of the KM functions identified could be found within many KMS products on the market. Before looking at products it is useful to have an understanding of what is required so that time and resources are not wasted. This understanding will be taken to the next action research cycle where SISTeM Cycle 2 can be used to make tangible decisions regarding procurement. The overriding issues, at this stage will be whether any such solutions are:
- systematically desirable,
- culturally feasible,
- organizationally value adding,
- informationally and technically feasible and
- ethically defensible [16]

These are perhaps the most important criteria that must be reached by any system before functionality is even considered. At a pragmatic level, implementing a KMS will help knowledge workers capture and store knowledge about their searching and appraising the evidence as they go. KMS could possibly provide decision support for those who have trouble in articulating their questions in a format that can be easily answered. While resolving KMS issues is a step in the right direction, it must be remembered that

"many organisations try to build KM programs and architectures before building the cultural collaborative or business foundations for these programs...they are of little value unless tied directly to easily seen business benefits.[24]"

Other practical decisions about purchasing a Knowledge Management System and its implementation are the material of work outside the scope of this paper, but will provide future scope to use Cycle 2 of SISTeM as a methodology. The success of this project was to unpack difficult issues and turn them into a ‘shopping list’ for selecting KM systems.

10. References
6. Rajendran M, Anderson J. Is standard (or universal) precautions effective in preventing the transmission of blood borne viruses (HIV, HBV, HCV) in the haemodialysis unit setting? What preventative measures have been effective? Melbourne, Australia: Centre for Clinical Effectiveness, Southern Health Care Network; 1999 22 October 1999.


