Where is the wisdom we have lost in knowledge?  
Where is the knowledge we have lost in information?  
*T.S. Elliot, "The Rock" 1934*

**Introduction**

This chapter is concerned with the evaluation and sharing of knowledge. In particular, it explores the potential value of applying the principles of evidence-based practice to these difficult, time-consuming but essential activities. It begins with an overview of evidence-based thinking which is placed in the context of the wider knowledge management arena. Following a short description of the successful adoption of evidence-based practice within medicine and healthcare, where mechanisms for the collection, analysis and dissemination of ‘evidence’ have been developed over the last decade, a number of suggestions are offered for the extension of evidence-based practice into a wider community. The need for systematic processes for the review of evidence, the importance and possibility of identifying
both appropriate research appraisal mechanisms and strategies for dissemination and use are highlighted and discussed together with the results of initial work in these areas. While offered within the context of building an evidence-based community, the specific issues that are explored in this chapter are relevant and significant to the knowledge management community whether or not evidence-based practice \textit{per se} ever becomes a realistic possibility.

\textbf{What do we mean by ‘evidence’?}

The Shorter Oxford Dictionary lists ‘facts or testimony in support of a conclusion, statement or belief’ as one of its meanings and it is this sense that is intended in the phrase ‘evidence-based practice’. The evidence is seen as comprising the results of academic research, reports of best practice and expert opinion. The use of the word evidence suggests that such knowledge is reliable and valid and can thus form the basis for good decision-making.

\textbf{Evidence-Based Thinking}

The use of ‘evidence’ as an important component for decision-making is clearly not a new phenomenon. As Sawyer has remarked “…information has, in fact, always been important in business dating back into antiquity…Knowing that a caravan or ship with certain cargo was about to arrive was a lever for making money in the Middle Ages…The so-called knowledge industries are really nothing new…What has really changed, and will be the hallmark of business in the 21st century is the level of attention paid to information and the importance assigned to it.”\cite{Sawyer, 1998, p6} To this we might add an additional characteristic – the globalisation of knowledge. Until the last decades of the 20th century, much knowledge held by or easily accessible to decision makers, was local, perhaps within an organisational or national community. However, with the increasing use of internet technology, knowledge generated or captured from anywhere in the world is easily accessible and potentially applicable to a local situation – the trick is being able
to identify which knowledge is most likely to provide a reliable foundation for effective decisions.

These issues were recognised in the medical community in the early 1990s, partly in response to increased pressure on the costs of healthcare from management, increased expectations of healthcare from patients and recognition of the importance of knowledge accessibility from within the community itself. Together these led to a new awareness of the cost of treatment, the limits to resources and the absolute need for efficient and effective use of existing resources. At the same time, research results continued to accrue rapidly and to provide a steady stream of new knowledge. Finding, assimilating and using this knowledge was identified as essential to effective clinical practice but constituted a very considerable burden on individual practitioners.

**What is ‘good’ evidence?**

The higher the quality of the evidence, the more successful the decisions that are based on it are likely to be. The characteristics of ‘good’ evidence are that:

- it is corroborated from a number of sources,
- it displays a clarity of reasoning in its construction,
- the means by which it has been arrived at is repeatable,
- there is either an absence of contradictory evidence or a feasible explanation for the existence of contradictory findings,
- it can be applied in other areas, i.e. it is generalisable,
- it has been tested

A practical response to these issues was the rapid development of both evidence-based medical and evidence-based healthcare (EBHC) communities. This was witnessed by a spate of exploratory and explanatory articles, a variety of new journals and bulletins such as ‘Evidence-Based Medicine’, as well as the appearance of a number of organisations, such as the Cochrane Collaboration, which collate, produce and disseminate evidence-
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based information. While still not universally accepted, evidence-based medicine (EBM) and healthcare are playing an increasingly significant role in knowledge management within the health community, not least of which has been the large amount of research that has been undertaken into the effective dissemination and utilisation of knowledge. Over the last decade, evidence based practice has also found a wider audience as other communities have looked to extend their fundamental principles into identifying ‘best practice’ in their own areas. Education, social policy, human resource management, nursing practice and information systems have all begun to explore the problems and benefits of creating and maintaining an evidence-focused community.

The issues of information overload

In all disciplines, academic research of varying quality and relevance, ‘expert’ opinion of varying degrees of bias and practical experience reports are accumulating at an ever-increasing rate and, enabled largely by internet technology, are increasingly available, although often in an un-evaluated and uncontrolled form. This proliferation, while holding numerous potential benefits, becomes a problem when either the volume of information acts as a barrier to careful and considered decision making or, if important and useful contributions to an area are obscured by conflicting, unsubstantiated or uncorroborated claims of effectiveness.

In academic circles, one response to this is an increasing reliance on integrative literature reviews. Cooper and Hedges (1994, p5) have pointed out that, “regardless of the cognitive capacities of scholars, expanding literatures require the periodic collecting, evaluating, and integrating of scholarship in order to bring coherence and perspective to a problem area.” The same phenomenon has been observed in both science (Garvey & Griffith, 1971) and the social sciences (Mazela and Malin, 1977). The problem, in itself is clearly not new, and academic scholarship has long recognised the importance of a review of relevant literature. What is new is the increased scale and scope of the literature, which make the completion of
substantial and reliable reviews difficult, if not impossible for individual researchers. In healthcare, for example, it has been estimated that over two million articles are published annually in over 20,000 biomedical journals (Mulrow & Cook, 1998) and while we have been unable to identify corresponding figures for other areas, we suggest that at even a tenth of these figures, the challenge is very real.

In her excellent book, Getting it Right: Avoiding the High Cost of Wrong Decisions, Deborah Sawyer suggests the following.

“When people in business sit down to make decisions, they have two basic tools at their disposal: their own brains and whatever information they have been able to gather to support their decision making.

Their brain resources include their training and education, their experiences and beliefs, their biases, and their intuition. On the information side of the equation, they may have an abundance of material at hand or, if they lack the resources or know-how to retrieve good information, they may have very little.” (p11)

While the challenge of remaining abreast of the current literature in any given subject area may be difficult for academic researchers, the problems are virtually insurmountable for practitioners. In medicine, empirical studies identified an average 8–13 year time difference between a treatment being proven to work in trials and its adoption in common practice (Chalmers, 1993). In the business community, driven by the need to provide effective solutions within tight deadlines and pre-determined budgets, most managers and practitioners would argue that they cannot afford to wait for the more reflective and tentative findings of academic research. This is particularly so, when even the researchers note the confusing, contradictory and disparate nature of some findings. (e.g. Hirschheim et.al., 1995; Batra & Srinivasan, 1992). Indeed, it may be that the very abundance of information creates either indifference to its use (Sawyer, 1998) or the common human tendency to ignore what is too difficult for the brain to manage. Instead, heuristics may be used to reduce the problem to a more
manageable level and decisions made on the basis of incomplete knowledge, informed not by ‘evidence’ but by prevailing practice and peer opinion. Many decisions may well be based, not on clear evidence of efficacy, but on personal familiarity, individual experience, astute marketing or current fashion.

However, it is not the amount or easy availability of information that is in itself most problematic but the difficulty of assessing the reliability and usefulness of all this information. A significant amount of information, whether printed or electronic, is anecdotal, out of date, inaccurate and incomplete or may even be deliberate disinformation (Sawyer, 1998). Extracting the reliable and useful, i.e. the best evidence, from this mélange is a skilled, time-consuming activity.

“...many people overlook the fact that availability of information is not the same thing as quality of information”. (Sawyer, 1998, p22)

**Evidence for Decision Making**

Evidence-based medicine has been described as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients” (Sackett et al., 1996). For this to occur, the effectiveness of healthcare interventions needs to be rigorously evaluated, the results of this evaluation need to be disseminated and then utilised by clinical practitioners (Appleby et al., 1995). Evidence-based healthcare extends the principles and practices of evidence-based decision-making to other health professionals, managers and consumers. A primary objective of evidence-based practice in healthcare has been to encourage and facilitate decision-making on the basis of ‘best practice’ rather than on the previous basis of expert opinion. This has resulted in the recognition that clinical treatment decisions should be tripartite, i.e. taking into consideration the three elements of best evidence, clinical judgment and patient preference. In order for this decision-making to be effective, best evidence must be easily accessible to the decision-makers and consequently a major focus of evidence-based practice continues to be on the
construction of formal, systematic and integrative reviews of primary research that periodically collect, evaluate and synthesise both scholarship and experience. The details of the systematic review process are described in the next section.

Evidence-based practice in medicine recognises three major components to effective clinical decision-making: 1) the experience and expertise of the decision-maker; 2) the preferences of the patient and 3) the best evidence of treatment outcomes as reported in global literature. This is known as Tripartite Decision Making.

The need for these high quality systematic reviews has led to the development of a formal methodology for their conduct which in turn has led to a systematisation of the means by which evidence, i.e. research findings, are both appraised and reported. Important aspects of these reviews, including the process that has been followed, the assessment criteria that have been utilised and the extent of the literature that has been accessed, are all made explicit within the review itself. However, the completion of a review is of little value unless the results are widely available and utilised. Consequently, there has been an increasing research focus on the best means of disseminating this evidence. One result has been the free on-line availability of comprehensive abstracts of every review, which includes both the major findings and the summarised opinions of the authors. Another effect has been that the results of the reviews themselves are not only open to scrutiny, but, through the recognised medium of the Cochrane Collaboration, are open to on-line discussion and debate.

The Cochrane Collaboration is an international network of individuals and institutions committed to preparing, maintaining and disseminating systematic reviews of research assessing the effects of health care. In 1979 Archie Cochrane expressed the opinion that the healthcare profession should have periodically updated, critical summaries of all relevant, randomised controlled trials of healthcare treatments. In response to this challenge, international efforts were made between 1985 and 1990 to collate and review various controlled
Evidence-based Practice and Knowledge Management

In knowledge management terms, evidence-based practice can be viewed, using the knowledge creation spiral of Nonaka
and Takeuchi (1995). The knowledge creation spiral is a dynamic process in which explicit and tacit knowledge are exchanged and transformed through four processes: socialisation, externalisation, combination and internalisation. Evidence-based practice is concerned with three of those activities: the identification and evaluation of explicit codified knowledge within communities; the synthesis of that knowledge into systematic reviews; and the dissemination and use of the synthesised explicit knowledge so that it is absorbed by members of the community.

The first activity within evidence-based practice presumess the existence of a body of explicit codified knowledge within a community. The systematic process of enquiry that creates new explicit knowledge is research (Neuman 2000), and corresponds to externalisation in Nonaka and Takeuchi’s spiral model. However, the explicit knowledge is “fragmented, disparate, often conflicting and sometimes unevaluated” (Atkins and Louw 2000). Relevant explicit knowledge is located using exhaustive searches of published and unpublished research studies that address a particular topic of interest. A process of critical review is then undertaken to evaluate the studies to identify which are of sufficient quality for inclusion in the systematic review.

The second activity within evidence-based practice is the synthesis of explicit knowledge into a systematic review. This corresponds to combination in Nonaka and Takeuchi’s spiral model. Approaches to evaluation and synthesis of explicit knowledge depend on the nature of the identified research, for example, whether the research was conducted using quantitative or qualitative research approaches. Systematic reviews must be credible, usable and useful.

The third activity within evidence-based practice is the dissemination and use of the synthesised explicit knowledge. Through use, members of a community should move from a state of “having knowledge” to “knowing”. Erich Fromm described this distinction thus: “having knowledge is taking and keeping possession of available knowledge (information); knowing is functional and part of the process of productive
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thinking.” (1978, p47). This corresponds to internalisation in Nonaka and Takeuchi’s spiral model. To make a difference, systematic reviews must be readily available to members of the community and must be used in everyday practice. Reviews must also be regularly updated to include new research developments.

Evidence Based Practice in Medicine and Healthcare

There is a wealth of literature describing the history, rationale and operation of evidence-based practice in medicine and healthcare and it is beyond the limits of this chapter to discuss them here. Instead, we will focus on providing a more detailed description of three significant contributors to successful evidence-based practice, systematic reviews, critical appraisal guidelines and dissemination issues, as part of which we discuss a successful dissemination strategy for medical evidence in Victoria, Australia, previously reported in Moody and Shanks (1999).

Systematic Reviews

As we have already noted, there is a long academic tradition of creating integrative reviews of previous research, although these have often been of an exploratory nature, with the primary purpose of providing a context for new research. In the course of such a review, previous findings may well be synthesised but generally with the goal of identifying interesting new research directions, rather than as an exercise in its own right. Consequently, it is unusual for the review process itself to be explicitly described and difficult to judge why certain literature has been omitted or other given particular prominence. In addition, the target audience for such reviews will usually be other researchers, not practitioners.

Evidence-based medicine, on the other hand, has identified an explicit need for reviews, easily understood by practitioners, which provide a snapshot of the most effective responses to specific situations suggested by current research. Indeed, during a formal systematic review, the world literature relevant
to a specific, carefully defined research question is accumulated. Every attempt is made to identify all potentially pertinent studies, including those published in conference proceedings, those awaiting publication and those published in languages other than English. The validity of the review findings is seen as being directly related to the comprehensiveness of the search and the thorough and unbiased nature of the search strategy. In addition, advocates of evidence-based medicine recognise that, in order to be credible, not only must the means of producing such reviews be as rigorous as the primary research it is collating, but also that the review findings have to be as open to peer review and scrutiny.

As a result, the National Health Service Centre for Reviews and Dissemination (NHSCRD) at the University of York in the UK, developed, and has continue to maintain, guidelines for undertaking systematic reviews of research on effectiveness (CRD4, 2001). These guidelines coalesce to form a prescriptive formal methodology, which aims to eradicate systemic and random errors as well as bias. Reviews thus created can help to establish whether primary research findings are consistent and can be generalised across populations, settings and treatment variations, or whether findings vary significantly by particular sub-sets (Mulrow, 1995). They can integrate potentially unmanageable amounts of information, and through critical exploration, evaluation and synthesis, separate the insignificant unsound or redundant from the salient and critical studies that are worthy of reflection (Morgan, 1986). Thus, although systematic reviews are labour and time-intensive projects of secondary research, the benefits are substantial and add considerable value to the primary studies on which they are based. As Mulrow (1995) comments, “the hundreds of hours spent conducting a scientific study ultimately contribute only one piece of an enormous puzzle. The value of any single study is derived from how it fits with and expands previous work, as well as from the study’s intrinsic properties. Through systematic review the puzzle’s intricacies may be disentangled”(p7).
Stage I – Planning the Review
- Identifying the need for the review
- Preparing a proposal for the systematic review
- Developing the review protocol

Stage II – Conducting the Review
- Identifying the relevant research
- Selecting relevant studies
- Assessing the quality of the studies
- Extracting data from the studies
- Synthesising the data

Stage III – Reporting and Disseminating
- Preparing the final report and associated publications
- Getting the evidence into practice

Figure 8.1. The Phases of the NHSCRD Systematic Review Framework

Full details of the guidelines for conducting a systematic review, which include clear justifications and explanations, as well as discussion on many related issues, are freely available at http://www.york.ac.uk/inst/crd/report4.htm. An outline of the framework is shown in Figure 8.1.

Quality Assessment and Critical Appraisal Guidelines
An essential early activity in the conduct of a systematic review is the construction of a well-defined and potentially answerable research question. This question generally takes the form of searching for particular outcomes from the use of a particular intervention on a specific population. The question is
then used as the basis for an exhaustive and comprehensive search in the world literature for any studies that appear relevant. Clearly, a tightly focused question helps to scope this search to more manageable proportions and detailed guidelines for searching have also been developed. Indeed, so important has searching become that a standard format for the reporting of such studies to facilitate it, is increasingly being adopted by both electronic and printed publications.

As reports are collected, their relevance to the question must be considered and explicit criteria are applied to all the studies, which have been accumulated. While only those which meet the inclusion criteria are considered further, comprehensive lists of all studies identified, including those excluded (together with reasons for their exclusion) are maintained and become part of the final report. This is designed both to add to the credibility of the final results through allaying fears that studies have been overlooked rather than rejected and also to increase the transparency of the process. Eventual users of the results of the review can see not only what evidence has not been included but why not and thus use their own judgement as to its validity.

The criteria used at this point are primarily based on the appropriateness of the study design to the question under consideration. A hierarchy of appropriate study designs is generally constructed during the development of the review protocol. This hierarchy lists in order of preference the type of research designs that are likely to provide the most reliable findings. All studies, which use the study design at the top of the hierarchy, will be included, at least initially, while those further down the hierarchy may not. An example of a typical hierarchy is illustrated in Figure 8.2.

Once it has been established which studies will be considered further, a detailed critical appraisal of each study is undertaken. This involves appraisal of each study's internal validity against a set of guidelines appropriate to its research design. Various checklists and scales are already established for commonly used study designs such as randomised controlled trials, but where they have not been established, an agreed set is constructed.
The individual studies, which emerge from this process as relevant and usable, present a robust set of valid evidence, which may be combined, statistically where appropriate, to provide an unambiguous answer to the original question.

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<td>Well-designed controlled trial with pseudo-randomisation</td>
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<td><strong>II-1b</strong></td>
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<td><strong>II-2c</strong></td>
<td>Well-designed cohort (retrospective study) with concurrent controls</td>
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<td><strong>II-3</strong></td>
<td>Well-designed case-control (retrospective) study</td>
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<td><strong>III</strong></td>
<td>Large differences from comparisons between times and/or places with and without interventions</td>
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**Figure 8.2 An example of a hierarchy of evidence (CRD4, 1996)**

**Dissemination and Utilisation Strategies**

It is clearly recognised that the findings of a review, which may be in the form of guidelines for clinical practice or may highlight the need for additional primary research, must be disseminated as widely as possible if they are to influence practitioner behaviour. Obviously, easy availability of the findings to practitioners is no guarantee that they will be used, but increasing availability and accessibility will improve the chances. Consequently, significant attempts are made to disseminate the findings both to the healthcare community and the public, both online and in print, in both the academic and
popular press and at varying levels of detail from full copies of the review to information leaflets.

The Clinical Information Access Project (CIAP) described by Moody and Shanks (1999) illustrates how explicit knowledge may be made available to members of a community, in this case clinicians in a large government health department. A reference group of clinicians was formed to specify requirements for a world-wide web-based information system to disseminate explicit knowledge in the form of evidence-based medicine reviews from the Cochrane Collaboration, research databases, pharmaceutical databases, and drug prescription and interaction databases. Extensive publicity and marketing programs were undertaken, users were provided with access to the system, training programs were introduced and feedback from clinicians was used to improve the system. The system had a strong and sustained increase in usage in the first two years after implementation, both at work and from home, and was considered a major success by the clinicians.

**Use of The Internet**

While the conduct of a systematic review is not dependent on internet technology, it is certainly facilitated by it and indeed the requirements of systematic reviewers themselves have begun to shape some of the online facilities that are provided. All the information on the conduct of systematic reviews and on the dissemination of findings is freely available via the Cochrane web-site at www.cochrane.org.au. Abstracts of the reviews held within the online Cochrane Library are freely available, although a subscription is charged for full papers.

In order to promote the comprehensive searching of world literature, significant effort has been put into creating search strategies, particularly for electronic libraries and databases. The desire to facilitate searching has led to a greater standardisation of paper abstracts and indexing. Use of the Internet has also allowed timely and open responses to published information. Critical comments are posted in response to systematic reviews and provide a means for
researchers and authors to publicly debate the findings. The electronic version of the British Medical Journal, eBMJ, also provides for ‘rapid responses’ to articles published in either version of the journal, providing an almost immediate feedback mechanism.

**The Wider Application of Evidence Based Practice**

Following the increasing success with which the evidence-based paradigm was being adopted by the healthcare community, other areas have also begun to explore its potential. In the business arena, this has been largely in the area of human resource management (Briner, 2000) and information systems (Atkins & Louw, 2000). We have been mainly concerned with investigations within the information systems (IS) field and consequently much of this section is based on this work. However, the general principles, the main issues and many of the problems that we have encountered are clearly applicable to the business community in general. Therefore, while IS remains the focus of this discussion, it is our belief that it is by no means exclusive and that it can stand as an exemplar for evidence-based practice in a number of business areas.

**Similarities and Differences**

In comparison with medicine and healthcare, information systems is clearly an immature discipline. Academic research in IS has only existed for around 30 years and for much of this time, technological advances, and their adoption by the practitioner community, have overtaken the research effort. In addition, innovative areas of IS use have emerged as practitioners have striven to meet the requirements of an increasingly computer-literate management. In such situations, publication and acceptance of innovative ideas can pre-date academic work by several years. Consequently, to gain a comprehensive and timely view of an IS issue it is not sufficient to focus only on peer-reviewed articles published in top academic journals. Quite aside from numerous conference proceedings and other journals of varying quality, many
interesting and challenging reports of IS practice exist in popular magazines and journals or are self-published on the worldwide web. The result is a rapidly growing body of knowledge that is fragmented, unrelated, frequently contradictory and not always well appraised. The Internet has also enabled a rapid growth in the availability of this information. It has been estimated that there were 800 million publicly accessible web pages in February 1999 (Lawrence & Giles, 1999), a number which has undoubtedly grown significantly since then.

There is clearly a number of significant differences between the practice domains of IS and healthcare. Much IS work, for example, is specific to an organisation or to a system and is focused on the need to gain or maintain a competitive edge. New knowledge in IS may also be proprietary or there may be economic disincentives to releasing it into the public domain. In addition, the rate of technological change can quickly render past IS practice irrelevant, although healthcare also faces this challenge and yet still finds value in its past. The nature of the practitioners themselves also differs. Unlike their healthcare counterparts, IS professionals are not always ‘licensed to practise’ or expected, as a normal part of their work, to be familiar with the latest research findings. In summary, the predominantly competitive culture of IS may serve to obstruct the take-up of some elements of evidence-based practice.

In research, too, there are differences that require exploration and careful consideration. The diversity of appropriate research methods in IS and the consequent need to relate research evidence to the appropriate theoretical base, are a significant difference. In addition, there is a general lack (and inappropriateness) of rigorous quantitative research studies and an increasing proliferation of interpretative research. However, while these differences are real, they do not necessarily undermine the potential of evidence-based practice to IS. Rather, they serve to highlight both some of the adaptations to the evidence-based framework that its adoption by IS would
require, and incidentally the challenges that the IS research community must anyway face.

However, a significant amount of similarity also exists. IS professionals too, are concerned with the effective use of resources and are faced with a bewildering amount of conflicting guidelines and statements of best practice. Consequently, there is a real danger that critical decisions may be based on incomplete or untested ‘knowledge’ and that considerable effort may be invested in the re-invention of solutions – a problem which IS practitioners are well aware of. As with healthcare, both commissioners and consumers of information systems have increasing expectations of the quality and complexity of those systems, and while the consequences of failure may not be literally fatal, they can often be severe.

**Potential Benefits**

A primary goal of evidence-based information systems would be to provide an easily accessible knowledge base, across a broad spectrum of IS issues, in the public domain. This knowledge base would provide a critical synthesis of both the latest findings of academic research and the current ‘best practice’ thinking of practitioners. Ideally, this would become the resource of first choice for anyone wishing to discover what was currently considered to be the most effective solutions for specific IS questions. Arguably, the Internet already provides such a resource, although due to its eclectic nature, it is more appropriate to consider it as part of the problem. One major difference between the information, as it is currently available, and the evidence-based practice of IS, is the extraction, critical evaluation, synthesis and dissemination of knowledge from both web-based and non web-based information.

The creation of such a validated and critically appraised knowledge-base would not only serve the IS practitioner community, but also, by providing validated summaries of existing work, it would assist in defining the boundaries of current knowledge. Areas of non-existent, inadequate or out-of-date knowledge could be more easily recognised. It could
therefore become a useful indicator of relevant and timely research directions and assist in the setting of new research priorities. Conversely, it could also highlight areas where research efforts, often confounded by ill-defined terminology, may be unnecessarily duplicated. In addition, researchers could use the knowledge base to inform not only their research focus but also its quality (Mulrow, 1995).

The benefits of an evidence-based culture in Information Systems (EBIS) would stem from the successful achievement of a number of objectives, in particular those of well-informed practitioner behaviour and well-informed research directions. The importance of this has been identified by Harvey and Myers (1995). “Scholars in the IS field are characteristic in that they must be concerned to generate valid knowledge which can, at least in principle, be informative to practice. Scholars in IS are expected to substantiate their contributions to practical knowledge by showing which contextual areas can benefit. Likewise, any practitioner is expected to justify their knowledge-seeking and generation activities against measures of the practicability of outputs” (p.14).

The need for critical appraisal guidelines for interpretive research

Interest in interpretive research in the information systems area has increased due to the potential to produce deep insights into information systems phenomena, including the management of information systems and information systems development (Klein and Myers, 1999). Interpretive research is an attempt to understand phenomena through the meanings that people ascribe to them. Walsham (1993) comments that interpretive methods of research in IS are “aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context” (p.4). Klein and Myers comment that “researchers, reviewers, and editors have raised questions about how interpretive field research should be conducted and how its quality can be assessed” (p.67). Walsham (1995) also recognises the lack of “a synthesised view of the nature and conduct of case
Evidence-based Practice

studies with specific reference to the field of computer-based IS" (p.74). Nonetheless, a number of authors have provided guidance on the conduct of high quality interpretive research (e.g. Miles and Huberman (1994); Klein and Myers, 1999; McKay and Marshall, 2000) and case studies, in particular (e.g. Yin, 1984; Walsham, 1995; Darke et al., 1998), although some are often either focused on specific problems or on specific aspects.

A holistic approach for assessing the quality of interpretative research is the use of critical appraisal guidelines. Critical appraisal guidelines provide an easily accessible and comprehensive checklist of questions specific to a type of research that can be used to evaluate the quality of a particular piece of research. They also provide practical guidelines for the conduct, presentation and dissemination of such research.

In information systems research, critical appraisal guidelines have so far only been developed for single case study research and action research. McKay and Marshall (2000) have created a set of guidelines for the conduct of action research, some of which are applicable to various forms of interpretative research. Atkins and Sampson (2002) have produced a comprehensive set of critical appraisal guidelines for assessing single case study research and these are shown in Figure 8.3. While we recognise that case study research can be positivist, interpretive, or critical, the appraisal guidelines developed for single case study research, are broadly interpretive. The case study guidelines developed by Atkins and Sampson (2002) were classified within a framework which grouped the guidelines according to: the 'way of thinking', the 'way of working', the 'way of controlling', the 'way of supporting' and the 'way of communicating' (Bronts et al.,1995). The use of such a framework was important because both the research approach, which is “a way of going about one’s research, embodying a particular style and employing different methods” and the research method, which is “a way to systemise observation, describing ways of collecting evidence and indicating the type of tools and techniques to be used during data collection” (Cavaye, 1996, p.227) were supported.
1. Is a credible argument given for why a case study is appropriate?
2. Are the philosophical stance and perspective of the authors stated?
3. Is there evidence that any bias is taken into account when performing data analysis?
4. Have the criteria for analysis been confirmed by an independent researcher?
5. Have any opportunities for various forms of triangulation been exploited?
6. Is the research process auditable?
7. Has relevant literature been used to support the selection of an appropriate theoretical framework to guide the research?
8. Does the study use appropriate theory to support the findings?
9. Does the study describe how the conclusions were arrived at and how they are justified by the results?
10. Are the assertions / conclusions made well grounded in the data?
11. Are the criteria used to select the appropriate case and participants clearly described?
12. Does the study provide a clearly formulated question describing an important IS issue?
13. Are the approaches and techniques for data collection and analysis described in detail?
14. Is the conceptual framework for the research explicitly described?
15. Does the study describe an orderly process for the collection of data?
16. Does the study describe and employ a systematic way to analyse the data?
17. Is the history and context of the research clearly described?
18. Are the aims and objectives of the study clearly stated?
19. Are limitations to the study acknowledged and described?
20. Does the study suggest if and how the findings might be transferable to other settings?
21. Is sufficient detail given to allow readers to evaluate the potential transferability of the research to other contexts?
22. Does the report identify questions or issues for future research?
23. Is the presentation of the research appropriate to the intended audience?
24. *Could this research potentially make a contribution to the work of IS practitioners?*
25. *Does the research provide new insights into some aspect of IS work?*
26. *Is the research presented in such a way that there is evidence of logical rigour throughout the study?*
27. *Does the study place the findings in the context of IS practice?*
28. *Does the study place the findings in the context of IS research?*
29. *Is the research process open to scrutiny?*

**Figure 8.3 Critical Appraisal Guidelines for Single Case Study Research (Atkins & Sampson, 2002)**

Future research in this area includes the development of critical appraisal guidelines for ethnographic and grounded theory research. In addition, the single case study guidelines could be extended to develop multiple case study appraisal guidelines. We also need to determine the need for critical appraisal guidelines for other types of research such as surveys and experiments, and perhaps even for data sources such as observation and participant observation (fieldwork), interviews and questionnaires.

**A systematic review methodology**

The York methodology, used by Cochrane, relies heavily on the existence of a large body of high quality, scientifically designed studies, particularly randomised controlled trials (RCTs) and on the use of formal statistical methods (meta-analysis) for combining the results of these studies. Data of this kind is sparse, if not non-existent, in IS and it is tempting to assume that meaningful systematic reviews in this field may be too difficult to conduct and therefore have little to offer. Certainly, it is unlikely that systematic reviews of IS research would have the rigour of their clinical counterparts but there is still much to be gained by this approach. Other areas such as nursing practice (Blomfield & Hardy, 2000) and education (Hammersley, 2000) are also beginning to recognise the potential evidence-based
practice, and with this must come the need for reviews which attempt the synthesis of less scientifically based studies. Indeed, this has already been recognised in healthcare (Greenhalgh, 1997; Britten et al., 1995) although the latest report from York comments on some of the difficulties (CRD4, 2001).

<table>
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<th>Phase 1 - Formulating the Question and Review Strategy</th>
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<td>Step 1 – Identify the need for a review</td>
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<td>1.1. Determine rationale for doing a review</td>
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<td>1.2. Determine review group personnel</td>
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<td>1.3. Conduct short background review of study area</td>
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<td>1.4. Recruit Advisory Group</td>
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<td>Step 2 – Specify the Problem</td>
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<td>2.1. Assess volume of literature</td>
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<td>2.2. Assess types of study design used in primary research</td>
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<td>2.3. Identify review scope</td>
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<td>2.4. Identify required outcomes from primary studies</td>
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<td>2.5. Identify effect modifiers that may be found in primary studies</td>
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<td>2.6. Identify potential validity issues</td>
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<td>2.7. Identify potential generalisability issues</td>
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<td>2.8. Prepare resource statement</td>
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<td>Meeting A – Confirm administrative aspects of the review</td>
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<td>Step 3 – Create the review protocol</td>
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<td>3.1. Determine the study question(s) and hypotheses</td>
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<td>3.2. Determine study inclusion criteria</td>
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<td>3.3. Determine proposed ‘hierarchy of evidence’</td>
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<td>3.4. Determine appropriate critical appraisal guidelines</td>
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<td>3.5. Determine literature search strategies</td>
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<td>3.6. Create data extraction sheets</td>
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<td>3.7. Determine likely synthesis strategies</td>
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<td>3.8. Produce review protocol</td>
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<td>Meeting B – Confirm scope of review and content of protocol</td>
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<td>Step 4 – Search the literature and retrieve studies</td>
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<td>4.1. Search electronic resources</td>
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<td>4.2. Hand search of leading journals</td>
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<td>4.3. Search grey literature</td>
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<tr>
<td>4.4. Consult leading researchers, practitioners and industry specialists</td>
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<tr>
<th>Phase 3 - Appraising the evidence</th>
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<tbody>
<tr>
<td>Step 5 – Assess studies for inclusion</td>
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</table>
5.1. Pilot the proposed inclusion criteria
5.2. Determine inclusion/exclusion of all retrieved studies
5.3. Construct table of all excluded studies
Step 6 – Assess validity of included studies
6.1. Confirm/modify the proposed rhizome of evidence
6.2. Confirm/modify the proposed appraisal guidelines
6.3. Assess validity of all included studies
6.4. Construct table of validity of all included studies
Meeting C – Check progress and plan for analysis
Step 7 – Extract Data
7.1. Pre-test the data extraction sheet
7.2. Extract data
Step 8 – Data Synthesis
8.1. Construct narrative overview
8.2. Undertake qualitative analysis
8.3. Undertake quantitative synthesis
8.4. Construct narrative of qualitative analysis
8.5. Construct appropriate representations of quantitative synthesis
8.6. Construct narrative on methods used for analysis and synthesis
8.7. Construct narrative on implications of missing data
8.8. Construct narrative on implications of bias within review

Phase 4. Disseminating the findings

Step 9 – Create Report
9.1. Assemble all documentation into structure of final report
9.2. Have report independently assessed for quality, content and relevance
Meeting D - Discuss Report Revisions and Dissemination
9.3. Prepare final report
9.4. Prepare dissemination plan
9.5. Prepare report summary
Step 10 – Disseminate Review Findings
10.1. Submit report for on-line publication and review
10.2. Submit report summary to selected journal(s)/publication(s)
10.3. Send abstract/summary report to interested parties.
The PRECISE methodology

Peer Reviewed Evaluation and Consolidation of IS Evidence (PRECISE) is a methodology that has been proposed and designed specifically for use in the area of information systems. However, it is applicable to a wide range of areas. It has been adapted from the methodology produced by the University of York (CRD Report, 1996), and is still under development.

In an attempt to explore the potential and identify some of the problems discussed above, a trial was conducted of a proposed systematic review methodology adapted to alleviate some of the more obvious difficulties (Wheeler, 2000). Various further issues were discovered as the trial progressed and the methodology presented here includes variations based on these.

The proposed methodology contains 10 steps that can be broadly grouped into four fundamental, and self-explanatory, phases which are illustrated in Figure 8.4.

Phase 1. Formulating the Question and Review Strategy

This phase covers the first steps phases of the methodology and is concerned with clearly defining both the aim and the requirements of the proposed review. It provides for an initial feasibility study and is focused on both clarifying the objectives of the review and designing the protocol under which the review will be conducted. In many respects, this is the most critical part of the review, as it is important that the techniques to be used are clearly determined, and that their resource implications are explicitly recognised. This allows the review to be scoped, and a realistic resource statement to be drawn up. It also provides the basis for a critical appraisal of the final review itself.

Another important activity of this step is the recruitment of an appropriate and available advisory group. This group, which should represent a range of views, contains both relevant experts and potential users of the review, including those recruited from professional groups, management and consumers. In addition, it is suggested that individuals who are qualified to comment on both the scientific and methodological
Evidence-based Practice

quality of the review, and thus the final report, are also included. The primary activities of this phase are summarised in Figure 8.5.

<table>
<thead>
<tr>
<th>Step 1. Identifying the need</th>
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<tr>
<td>Checking for existing or on-going reviews</td>
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<tr>
<td>Recruiting of advisory group</td>
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<tr>
<td>Recruiting of reviewers</td>
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<tr>
<td>Gathering background information</td>
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<tr>
<td>Background research &amp; problem definition</td>
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<tr>
<td>Assessing the volume of literature</td>
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<tr>
<td>Finalising the question</td>
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**Step 2. Assessing study designs of primary studies**
Identification of questions, outcomes, effect modifiers, validity issues, generalisability issues

**Step 3. Requirements for the review protocol**
Determining inclusion criteria, search strategies, validity measures, data extraction methods, study synthesis method

Figure 8.5. Primary Tasks of Phase 1.

**Phase 2. Searching the literature**
Figure 8.6 summarises the main activities of Phase 2 which is concerned solely with the search for, and the retrieval of, all relevant papers and articles. The intention is that the search is as comprehensive as possible within the requirement constraints that have been determined in the previous step. As the avoidance of bias is a major issue, the search should not be limited to published material and every attempt should be made to investigate the relevance of unpublished studies, such as
theses and industrial studies. In addition, while much of the material is likely to be in English, the translation and inclusion of relevant material in other languages would be encouraged, wherever feasible. The importance of determining effective searching strategies, both electronic and manual, cannot be over-emphasised.

<table>
<thead>
<tr>
<th>Step 4. Literature search &amp; study retrieval</th>
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<tbody>
<tr>
<td>Identifying literature sources</td>
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<tr>
<td>Identifying search strategies for each source</td>
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<tr>
<td>Retrieving required literature</td>
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<tr>
<td>Consulting with leading researchers</td>
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<td>Consulting with leading practitioners</td>
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Figure 8.6. Primary Tasks of Phase 2

Once a comprehensive list of potentially relevant material has been constructed, it should be circulated to the subject experts, both academic and practitioner, for their comments and advice. They would be asked to check the list for completeness and to identify any on-going research that they are aware of that has not been included. Finally, in some situations, it may be appropriate to approach companies who undertake their own research in the area but who do not generally publish that research for reasons of commercial sensitivity.

**Phase 3. Appraising the evidence**

Steps 4 to 7 constitute the third step of the methodology and are concerned with the actual conduct of the review. Here the studies are appraised for inclusion in the review, an activity which should be carried out independently by more than one reviewer, to assist in minimising reviewer bias. Based on the criteria determined by the agreed protocol, each study's relevance to the question, type of study design (e.g. random controlled tests, reports of expert committees) and design quality is appraised. Data collection forms, also agreed in the first step, are used to extract and record the required information from
each study. It is recognised that there will be occasions on which important data is missing from an otherwise useable study and in this situation attempts would be made to contact the authors directly.

<table>
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<tr>
<th>Step 5. <strong>Assessment of studies for inclusion</strong></th>
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<tbody>
<tr>
<td>Assessing against selection criteria</td>
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<tr>
<td>Making inclusion decisions</td>
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<td>Checking inclusion decisions</td>
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<th>Step 6. <strong>Assessing the validity of the studies</strong></th>
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<tbody>
<tr>
<td>Grading the studies</td>
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<td>Assessing quality of study design</td>
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<td>Assessing suitability of findings</td>
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<tr>
<th>Step 7. <strong>Data extraction</strong></th>
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<tbody>
<tr>
<td>Extracting required data</td>
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<td>Contacting authors for missing data</td>
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<tr>
<th>Step 8. <strong>Data synthesis</strong></th>
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<tr>
<td>Preparing qualitative overview</td>
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<tr>
<td>Undertaking meta-analysis</td>
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<tr>
<td>Testing homogeneity</td>
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<tr>
<td>Investigating differences</td>
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<tr>
<td>Combining appropriate studies</td>
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<tr>
<td>Reporting and analysing missing data</td>
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<td>Reporting on bias</td>
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Figure 8.7. Primary Tasks of Phase 3

The results of the studies are now analysed and synthesised. The York methodology suggests that

“The overall aims of the synthesis are (1) to provide where sensible, an estimate (estimated) range of the average effect of the intervention, (2) to investigate whether the effect is roughly the same in different studies, settings and participants, and if not, then (3) to investigate apparent differences in the effectiveness of the intervention. These aims can be achieved through a narrative overview sometimes complemented by the use of formal statistical (meta-analysis) techniques” (CRD REPORT 4, 1996).
Phase 4. Disseminating the findings

The final phase incorporates the final three steps of the methodology. The report of the results of the review will be structured according to predefined guidelines. It includes a detailed description of the methodology and the assessment criteria used, details of both the included and excluded studies, a discussion of the potential biases in the review and the implications of the findings. It will also highlight any implications for further research that have been identified.

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<tr>
<th>Step 9. Create report</th>
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<tr>
<td>Writing the final report</td>
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<tr>
<td>Analysing the robustness of results</td>
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<td>Indicating future research directions</td>
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<td>Reviewing quality and relevance</td>
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<th>Step 10. Dissemination plan</th>
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<tbody>
<tr>
<td>Researching current practice</td>
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<td>Developing a dissemination plan</td>
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Figure 8.8. Primary Tasks for Phase 4

Once complete, the report is submitted both to the advisory group and to other referees for their comments. The report is assessed for its scientific quality, its completeness, its relevance and potential usefulness. The report is refined, as appropriate, by additions or alterations that may be suggested by this activity.

Finally, a plan for the dissemination of the information contained in the review is constructed. There has been a significant amount of research, since the publication of the CRD Report 4, into the most effective ways of using systematic reviews to influence practitioner behaviour (e.g. Cook et al., 1997; Haines and Donald, 1998) and it remains an active area of on-going research.
Results of the PRECISE trial
From the outset, it was clear that a number of limitations were going to impact considerably on the nature of the trial. Conducted as part of a student's postgraduate qualification, time was always going to be restricted, and in a study such as this, this was a severe limitation. Even where effective search strategies exist, a comprehensive literature search was never a realistic possibility. Secondly, while the methodology had been constructed, it was clear that there were unlikely to be any effective guidelines for the creation of a useful hierarchy of evidence, and despite some literature suggesting appropriate study design for different kinds of IS questions (e.g. Galliers, 1993), we lacked both the knowledge and the time to create a robust hierarchy. Consequently, a rudimentary hierarchy was constructed consisting of:

1. Academic single case study
2. Industrial single case study
3. Academic multi case study
4. Industrial practice report

We were also aware that critical appraisal guidelines for qualitative research were not well established and that we would not have the time to develop our own.

In recognition of these limitations, we decided from the outset that we would be selective in our literature search and look only for case studies or reported action research on our chosen area, identifying strategies for the successful implementation of a data warehouse in medium to large organisations. Neither did we create an advisory group, although later in the trial we recognised that it would have provided a very useful sounding board for exploring some of the issues we uncovered.

The most significant issue that we identified was the importance and difficulty of including important practitioner reports into the systematic review. Our original search identified 112 studies which appeared relevant, of which less than 10 were from academic researchers. All the rest were
detailed practitioner reports which equated loosely to the definition of a single case study or to an industrial practice report. It appeared at first glance that much useful information was to be found in the industry studies. However, once we began to apply the critical appraisal guidelines, it also became clear that almost all of the industry reports would not be included. Written for a primarily practitioner audience, they did not in general provide sufficient information about the conduct of the study to determine its reliability. Indeed, after the first exercise in appraisal, all but one of the practitioner studies were excluded. This provided us with a real conundrum, as we seemed in danger of excluding potentially valuable information because of a lack of apparent rigour. We revisited the appraisal guidelines and looked instead to identify the most significant. If a study failed on these counts (we termed them fatal flaws), only then would they be excluded. This allowed us to preserve some credibility in the eventual findings without completely abandoning the principles of rigour. Clearly, this was a pragmatic compromise but it highlighted for us that further work was needed to establish the criteria by which non-academic studies could be evaluated.

One other related issue concerned the construction and uses of an effective hierarchy of evidence. In particular, the question of whether it is appropriate to even attempt to build such a structure when dealing with qualitative research, which after all is primarily concerned with recording as many different perspectives of a situation as possible. Later suggestions have been made that it may well be more appropriate to consider constructing a ‘rhizome’ of evidence rather than a hierarchy. With such a structure, studies of any design could be included, providing that they were well conducted and relevant to the question. We now consider that this approach could well enhance the value of the review’s findings.

Rhizomatic structures allow connections to be established between any two points on the structure’s surface and are put forward as the basis for developing new networks of communication. The philosophers Gilles Deleuze and Felix
Guatarri considered the rhizome a useful model for how systems should develop, bypassing established hierarchies and operating in a non-hierarchical manner. The Internet could be viewed as having a rhizomatic form of operation. (Sim & van Loon, 2001)

Despite its limitations and problems, the overall experience of conducting the pilot review was a positive one. Many aspects of the methodology worked as planned, and it is hoped to undertake a more extensive review in the near future.

**Implications of evidence based practice for the KM community.**

Evidence-based practice has a long and successful history in medicine. Mature and sophisticated guidelines are available for critical appraisal and synthesis of clinical research. Systematic reviews are widely available and regularly used by clinicians. The successful application and use of evidence-based practice in the discipline of information systems would have some important implications for the knowledge management community, including:

- demonstrating that evidence-based practice is a viable approach to the sharing and utilisation of explicit knowledge within communities, and encouraging use of the approach in other discipline areas;
- providing formal approaches for the evaluation and synthesis of explicit knowledge within communities;
- providing strategies for the dissemination and use of explicit knowledge within communities;
- providing a mechanism by which “best practice” in knowledge management itself may be identified, synthesised and disseminated to the knowledge management community.

**Conclusion**

In this chapter, we have highlighted some major issues for all those interested in knowledge management in any arena. The
first of these is concerned with how can we best collect and recognise useful information or knowledge. The second concerns the challenge of how best to disseminate this knowledge, to maximise its chances of being found by those who need it, when they need and to ensure that it is used and eventually becomes tacit. We have suggested that the paradigm of evidence-based practice as it has been developed in the medical and healthcare communities, provides a fruitful area for investigation. The nature of much business knowledge will probably ensure that evidence-based communities in our areas would need to develop along rather different lines, although continuing to be based on the same basic principles. In summary, evidence-based practice, which involves the evaluation, synthesis, dissemination and use of empirical research findings to improve practical decision-making, is essentially a response to the challenge of ‘information overload’. In T.S. Elliot’s terms it is an attempt to find the knowledge that has been lost in information.

References


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