Division of Informatics, University of Edinburgh

Centre for Intelligent Systems and their Applications

Knowledge Management Techniques: Teaching & Dissemination Concepts

by

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Abstract :

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The concepts support organisations who embark on a knowledge management programme. They promote the importance of knowledge management and the awareness of how knowledge management can be accomplished within, and across, operational divisions; create an awareness of a framework to achieve knowledge management; and establish a group of personnel who have skills in knowledge management techniques to enable them to facilitate the development, maintenance, use and sharing of the organisations knowledge assets.

The main objective is to ensure that knowledge management techniques are rolled out across the organisation. Importantly these concepts provide the organisation with the necessary training in the use of techniques to identify, analyse and manage knowledge assets.

Keywords :

Knowledge Management Techniques:

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Summary

This paper describes knowledge management teaching and dissemination concepts to support the training of professionals in an organisation to manage their knowledge assets. They are based on AIAI's experience of working with large organisations to establish a technical knowledge management framework and to support their personnel in implementing the framework.

The concepts support organisations who embark on a knowledge management programme. They promote the importance of knowledge management and the awareness of how knowledge management can be accomplished within, and across, operational divisions; create an awareness of a framework to achieve knowledge management; and establish a group of personnel who have skills in knowledge management techniques to enable them to facilitate the development, maintenance, use and sharing of the organisation's knowledge assets.

The main objective is to ensure that knowledge management techniques are rolled out across the organisation. Importantly these concepts provide the organisation with the necessary training in the use of techniques to identify, analyse and manage knowledge assets.

1. Introduction

AIAI has developed teaching and dissemination concepts to support the management of knowledge assets in an organisation. The concepts described in this paper are based on our experience of working with large organisations to establish knowledge management initiatives and support to their personnel in implementing the associated knowledge management programme. They are also based on over ten years experience of training knowledge engineers in a methodological approach to analysing and modelling knowledge. This paper describes the knowledge management approach that we employ and describes

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how the techniques taught in a formal classroom setting are put to practical use within the organisation.

For any teaching and dissemination there is a need to recognise the applicability of different levels of teaching required. In this case, knowledge management at the strategic level requires the organisation to *analyse* and *plan* its business in terms of the knowledge it currently has and the knowledge it needs for future business processes. At the tactical level the organisation is concerned with *identifying* and formalising existing knowledge, *acquiring* new knowledge for future use, *archiving* it in organisational memories and *creating systems* that enable effective and efficient application of the knowledge within the organisation. At the operational level knowledge is *used* in everyday practice by professional personnel who need access to the right knowledge, at the right time, in the right location.
Therefore using these three perspectives and from considering the knowledge management dissemination requirements of the large organisations we have worked with, three distinct target profiles have emerged:

1. **Knowledge Development Managers** who need a business-oriented perspective of available tools and techniques to manage knowledge assets better. There is typically a senior member of the organisation who has the remit of managing the knowledge management initiative, identifying key knowledge management projects and ensuring that these projects meet the overall business objectives of the organisation.

2. **Knowledge Developers** who need to be able to capture, structure and analyse knowledge by working with the appropriate professional personnel. The captured knowledge is then structured, analysed and may be distributed in reports, or through intranets, or implemented in knowledge-based systems. Knowledge Developers range from IT specialists with good programming skills to retrained professionals with a good understanding of their knowledge domain. They are drawn from the many business units in the organisation. These are the personnel whom the organisation have selected to establish their knowledge asset base.

3. **Professional Personnel** who need to be aware that their knowledge can be managed effectively and need to appreciate how it can be more widely shared and re-used within the organisation. It is important that once the organisation has established a knowledge management programme, these knowledge workers appreciate its importance and understand how to pro-actively contribute.

The overall approach which we take for knowledge management is a *modelling* approach - in other words, decisions are based on models of the organisation. However we have found that the three groups listed above need different perspectives on the knowledge assets:

1. **Knowledge Development Managers** need a strategic perspective on all knowledge assets. They need to understand the current state of the assets and to form a vision of how these knowledge assets could be improved or utilised to move the organisation forward.

2. **Knowledge Developers** need a comprehensive understanding of individual knowledge assets. They need to understand all the processes, roles, rights, and constraints associated with each knowledge asset, so that they can represent everything that may be relevant when describing or applying that knowledge asset.

3. **Professional Personnel** need to know about the existence of relevant knowledge assets and must understand how to apply them at the operational level.

This paper focuses on the techniques we employ for managing knowledge within the organisation. These are drawn from two distinct areas:

- the techniques that have been used previously from business management, for example, SWOT (Strengths Weaknesses Opportunities Threats) analysis; balanced scorecards (Kaplan and Norton (1996)); process modelling languages such as the IDEF Process Flow and Object State Description Capture Method (Mayer, Cullinane, de Witte, Knappernberger, Perakath and Wells (1992)); and agent/communication modelling techniques such as RADs (Role Activity Diagrams, Ould (1993));
- knowledge modelling techniques that have been used previously for the disciplined development of knowledge-based applications such as CommonKADS (Benus (1993) and Schreiber, Akkermans, Anjewierden, De Hoog, Van De Velde, and Wielinga (1998)).

It must be recognised that the ultimate success of any knowledge management programme for a particular organisation will also depend critically on the attitude and culture adjustments of its key workers.

The paper consists of six sections. This introduction establishes the scope and purpose for the paper and gives the necessary background information to support it. Following this, a section explains the need for knowledge management. Section 3 of this paper puts our knowledge management teaching and dissemination concepts into context by establishing the terms we use and the approach we promote. Section 4 describes the training modules we have established. Section 5 details how the methods and techniques taught are used in practice within organisations. Finally in Section 6 we summarise our approach and give concluding remarks.

2. Why Manage Knowledge?

The success of businesses in the 1990's in an increasingly competitive marketplace depends critically on the quality of knowledge which those organisations apply to their key business processes. For example the supply chain depends on knowledge of diverse areas including raw materials, planning, manufacturing and distribution. Likewise product development requires knowledge of consumer requirements, new science, new production techniques, marketing etc.

Knowledge assets are the knowledge regarding markets, products, technologies and organisations, that a business owns or needs to own and which enable its business processes

to add value and generate profits. Knowledge management is not only about managing these knowledge assets but managing the processes that act upon the assets. These processes include: developing knowledge; preserving knowledge; using knowledge, and sharing knowledge. Therefore, **knowledge asset management** involves the identification and analysis of available and required knowledge assets and knowledge asset related processes, and the subsequent planning and control of actions to develop both the assets and the processes so as to fulfil organisational objectives.

The challenge of deploying the knowledge assets of an organisation to create competitive advantage becomes more crucial because:

- The marketplace is increasingly competitive and the rate of innovation is rising, so that knowledge must evolve and be assimilated at an ever faster rate.
- Corporations are organising their businesses to be focused on creating customer value. Staff functions are being reduced and so are management structures. There is a need to replace the informal knowledge management of the staff function with formal methods in customer aligned business processes.
- Competitive pressures are reducing the size of the workforce which holds this knowledge.
- Knowledge takes time to experience and acquire. Employees have less and less time for this.
- There are trends for employees to retire earlier and for increasing mobility, leading to loss of knowledge.
- Trans-national sourcing operations introduce increasing complexity.
- A change in strategic direction may result in the loss of knowledge in a specific area. A subsequent reversal in policy may then lead to a renewed requirement for this knowledge, but the employees with that knowledge may no longer be there.

Organisations are realising how important it is to "know what they know" and be able to make maximum use of the knowledge. This is their *organisational memory* (Kühn and Abecker 1997). These knowledge assets reside in many different places such as: databases, knowledge bases, filing cabinets and peoples' heads, and are distributed right across the organisation (see Figure 1). All too often one part of an organisation repeats work of another part simply because it is impossible to keep track of, and make use of, knowledge in other parts. Organisations need to know:

- what their knowledge assets are;
- what their knowledge related-processes are;
- how to manage and make use of these assets and processes to get maximum return.

Within an organisation, most knowledge assets will consist of knowledge gained from experience of any of the organisation’s business processes, or from research and development, or from knowledge employees had prior to joining the organisation. Such knowledge will initially be generated within the minds of experienced staff. When these staff apply their experience (or their newly researched techniques) to performing business processes, the knowledge assets may be implicitly stored in the results that they produce. Over time, it may be that the experienced staff are encouraged to write down their

experiences in a procedural manual for the education of more junior staff, so it is possible that in-house manuals also contain knowledge assets; in these days of technological advance, any consideration of manuals must also include e-mail bulletin boards, intranets, and other electronic media, including videos. Finally, it is possible that software has already been developed with the explicit aim of capturing knowledge assets - for example knowledge-based systems which provide decision support for complex processes.

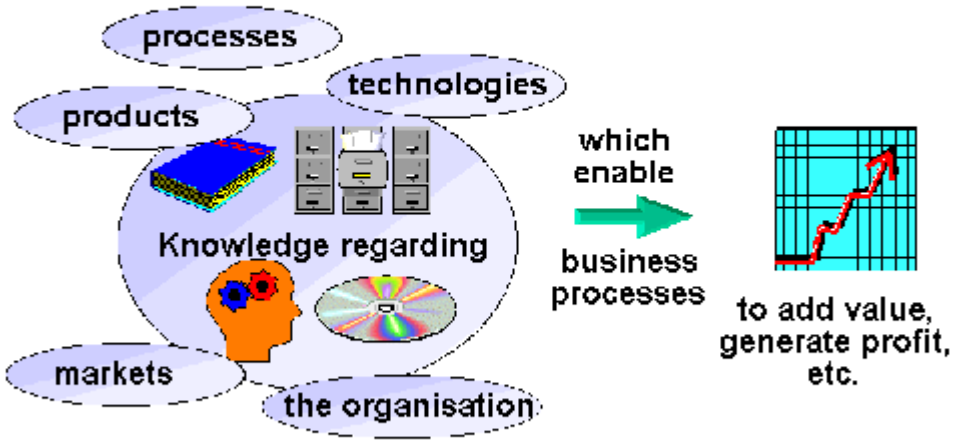

Figure 1: Knowledge Assets

However as organisations become aware of the importance of managing their knowledge, they also realise that most traditional organisational policies and controls focus on their tangible assets and leave unmanaged their important knowledge assets.

There are many problems associated with finding out about these knowledge assets and being able to use them in an efficient and cost-effective manner. Organisations need:

- to have an enterprise-wide vocabulary to ensure that the knowledge is correctly understood;
- to be able to identify, model and explicitly represent their knowledge;
- to share and re-use their knowledge among differing applications for various types of users; this implies being able to share existing knowledge sources and also future ones;
- to create a culture that encourages knowledge sharing.

3. A Knowledge Management Approach

Organisations need to establish teaching and dissemination standards for their business to enable them to manage their knowledge assets better.
They are required to:

1. promote the importance of knowledge management and the awareness of how knowledge management is to be achieved within, and across, operational divisions;
2. create an awareness of a framework to achieve knowledge management;
3. develop a skill base of personnel who have knowledge management skills to enable them to facilitate the development, use and sharing of the organisation's knowledge assets.

Management of knowledge assets is difficult for reasons such as :

- knowledge exists at different levels of abstraction whose relevance depends on the user;
- the value and acceptability of knowledge varies greatly depending on the user;
- knowledge does not have a fixed quality, it becomes out of date as time elapses;
- knowledge is intangible and often incomplete, and is therefore very difficult to describe.

However, methods and techniques from the field of Artificial Intelligence, and in particular knowledge engineering, have come a long way towards addressing the capture and structuring of an organisation's knowledge assets. There are tools to support the capture, modelling, validation, verification and maintenance of the knowledge. Common KADS, (Schreiber, Wielinga, de Hoog and Akkermans (1994)) (Schreiber, Akkermans, Anjewierden, De Hoog, Van De Velde and Wielinga (1998)), the most widely used methodology for knowledge based systems development in Europe, views the construction of knowledge based systems as a modelling activity, where each model represents a specific view on the problem of engineering an application. This modelling approach has been extended to knowledge management.
Developments in enterprise modelling methods and tools (Stader (1996)) provide another useful source of techniques for knowledge management. Enterprise modelling (including business process modelling) is typically carried out to gain a greater understanding of an organisation - how things are, how things could be, factors affecting change in the organisation etc. - in order to bring about improvement in processes, people and products. From this description, it is clear that knowledge management relates closely to enterprise modelling and both support each other. Dieng, Corby, Giboin and Ribière (1998) provides a preliminary survey of some methods, techniques and tools aimed at managing an organisation's knowledge.

Our recommended approach is a *multi-perspective* modelling approach - that is, several models need to be developed, each of which represents a different perspective on the organisation (Kingston, Lydiard and Griffith (1997)). The recommended perspectives can be characterised as "How, What, Who, Where, When and Why"

- How the organisation carries out its business - modelling the processes which an organisation performs in order to perform its task(s).
- What the processes manipulate - modelling the resources which organisations create, destroy, use or change while performing its processes.
- Who carries out the processes - modelling roles which people perform, which may include issues of authority (who is responsible for a process) and permission (who is allowed to carry out a process).
- Where a process is carried out - unless all processes are carried out by a single individual, this requires modelling of the communication between whichever people, computer systems, or external organisations are performing various processes.

- When a process is carried out - this specifies the control over processes (which processes must come before others, which processes must be carried out within a certain time, etc.).
- Why a process is carried out - the rationale for performing a process. This perspective is somewhat different from the others, in that it is about justification rather than description of what happens. Sometimes it is left uncompleted; if it is prepared, it is usually done in text rather than diagrams.

A variety of modelling techniques are used - tabular, process flow diagrams, hierarchical task diagrams, etc.

The knowledge management framework which we use was originally based on work described in van der Spek and de Hoog (1995). Knowledge management is seen as a cyclic process of *identifying* knowledge assets which are potentially valuable to the organisation, *analysing* the knowledge assets to determine which ones need to be managed better, *selecting* actions which disseminate, apply or otherwise manage these knowledge assets, and then *reviewing* progress to decide what to do next (see figure 2).

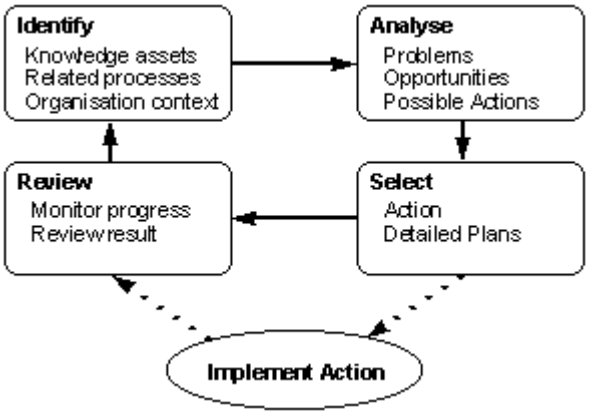

Figure 2 The Knowledge Management Framework

Our Knowledge Management approach is based on the need to identify not just the assets but the knowledge management related processes and how these can be managed under the identify, analyse, action and review framework

4. The Teaching and Dissemination Process

Our teaching and dissemination concepts are based around a number of training modules which focus on process, organisational and knowledge modelling techniques to support the management of knowledge assets. This requires the explicit recognition of the knowledge and where it resides; how and why the knowledge is needed/used; who is responsible/owns the knowledge; any difficulties/bottlenecks in deploying the knowledge; and ways to retain/improve the knowledge.

However, the success of the teaching and dissemination also depends on all workers awareness of knowledge management. With this in mind the training modules were developed to:

- show the importance of knowledge management;

- promote better ways of using knowledge;
- spread awareness of knowledge management tools and techniques;
- create an integral knowledge management skills base within an organisation.

The modules are in the form of half-day, one-day and two-day seminars that can be given at various key locations within a large organisation. Plenty of time is available for discussion of the audience's own knowledge assets and using these as examples to explore concepts. Ideally all modules are introduced by senior managers who are familiar with the entire operations of the organisation and appreciate the knowledge management issues.

We started teaching knowledge management techniques in 1996 and since then have used two important sources of review, namely the feedback from the people who attended the modules and, importantly, the assessment of the stakeholders in the organisation responsible for ensuring the organisation progressed its knowledge management initiative. This feedback has resulted in the current four training modules described below.

As well as the precise description of the module content, in section 5 we provide discussion on why specific techniques have been included and, importantly give examples of how they are used in practice.

4.1 Knowledge Management Awareness Seminar

The objective of this seminar is to enable an organisation's personnel to appreciate the importance of managing knowledge and be aware of how this can be achieved from the point of view of their particular work. The main topics covered by the seminar are an appreciation of the relevance of:

- the importance of managing knowledge;
- how and why the knowledge is needed/used;
- who is responsible/owns the knowledge;
- ways to retain/improve the knowledge.

It is important to get as many staff as possible to attend these awareness seminars therefore they are typically scheduled to last no more than half a day. Two identical seminars can be held in consecutive weeks to ensure a wide attendance.
We have found that it is beneficial for the success of these seminars for a senior member of the organisation, ideally a member of the Board, to introduce the seminar and to give a short introduction to the importance of knowledge management to the organisation. This backing by senior management is vital for the motivation of the personnel.

4.2 Introduction to Practical Knowledge Management

The objective of this one day training module is to ensure personnel can contribute to the company's framework for managing knowledge and give them an introduction to the major practical aspects of knowledge management. The main topics covered by the course:

- introduction to knowledge management

⇒ definitions and terminology
⇒ context of and motivation for knowledge management
- overview of a knowledge management framework
⇒ identifying and modelling knowledge assets and processes
⇒ performing analysis
⇒ selecting and performing a knowledge management action
- pointers to knowledge management techniques.
- how the organisation intends to achieve its knowledge management goal.

Necessary for success is the importance of relating the knowledge assets and processes in the module to those of the organisation. This promotes good discussion both during and after the session. Therefore in the financial sector examples could be:
- the underwriter's knowledge of risks and exceptions
- business analysts' knowledge of effective and efficient loan application process design.

In the manufacturing industry knowledge of products and processes are vital assets. For example:
- the supply chain depends on knowledge of raw material, planning, manufacturing, distribution, etc.,
- product development requires knowledge of consumer requirements, new science, marketing, etc.

4.3 Foundations for Practical Knowledge Management

This course is based around discussion sessions, its objective is to provide personnel with a disciplined approach to knowledge management based on the knowledge management framework described earlier. The topics covered include:
- what is a knowledge audit
- organisational modelling to identify problems and opportunities
- selecting and carrying out a knowledge management action
- adoption of a knowledge management strategy
- overview of IT support for knowledge management
- developing and using knowledge asset road maps

There is a practical element to the module which is based on the organisation's specific domain.

4.4 Foundations for Knowledge Engineering

This is a 2 day module and it objectives are to provide the organisation's personnel with a disciplined approach to knowledge mapping based on the CommonKADS methodology, teaching them how to use knowledge modelling techniques to support the explicit identification of knowledge.

In establishing the content for this module we considered the existing content of our 3 day Knowledge Engineering Course and decided which techniques had a wider relevance to knowledge management rather than just knowledge-based systems development. The topics include:

- introduction to knowledge engineering and knowledge modelling:
  ⇒ overview of the CommonKADS models
  ⇒ models in the context of knowledge management
- domain modelling
- structured knowledge elicitation techniques for domain knowledge
- task analysis and process modelling
- structured knowledge elicitation techniques for task knowledge.

There is a significant practical element to the module and where possible, tailored examples in it are based on the organisation's specific applications.

Some of the practicals are paper based, others use the tool PC-Pack. We have found this useful because of the dynamic nature of knowledge capture provided by the tool - captured knowledge can immediately be viewed on the screen, where it can be criticised by experts or scrutinised by knowledge engineers for accuracy of structuring as well as accuracy of content.

4.5 Matching Training Modules to Target profiles

The training modules are matched to the following target profiles.

1. **Knowledge Development Managers** who need a strategic perspective on knowledge assets. *Introduction to practical knowledge management* and *Foundations for knowledge management*.
2. **Knowledge Developers** who need a comprehensive understanding of individual knowledge assets. They need to understand multi-perspective modelling and knowledge acquisition techniques both for declarative knowledge and for procedural knowledge: *Introduction to Practical knowledge management; Foundations for Knowledge Engineering; Foundations for Knowledge Management.*
3. **Professional personnel** who need to know about the existence of relevant knowledge assets and must understand how to apply them at the operational level: *Knowledge Management Awareness Seminar.*

5. Putting the Techniques to Practical Use

This section discusses some of the content of the training modules in more detail. It also gives examples of checklists and templates that are provided to the Knowledge Developers to use in their knowledge management activities.

5.1 Identifying Knowledge Assets & Related Processes

5.1.1 Identifying Knowledge Assets

Examples of different types of assets that might need to be identified are:
Technology assets such as:

- technical know how
- technical designs & products

- manufacturing technology
- R&D results & patents.

Codified knowledge such as:

- company procedures
- operating guidelines
- knowledge-based systems
- lesson learnt work books and laboratory books
- documented expertise.

Human knowledge such as:

- management expertise
- marketing expertise
- operational expertise.

To Knowledge Developers it must seem hard to decide whether identifying knowledge assets is a black art requiring in-depth knowledge of an organisation plus excellent intuitive skills, or whether it is simply a matter of asking the experts who makes the best decisions, or asking the workers where they look for knowledge when they have a problem. The truth is somewhere between the two extremes; having identified possible knowledge assets by a combination of knowledge modelling and the ask-the-workers method, it is necessary to answer a number of questions about each knowledge asset. These questions assess the *content*, the *availability* and the *use* of each potential knowledge asset (Van der Spek and Spijkervet (1997)).

5.1.1.1 Content, Availability and Use of Knowledge Assets

The content of a knowledge asset consists of the *domain* of knowledge, the *type* of the knowledge, and the *quality* of the knowledge.

- If an accepted classification scheme characterises the *domain* comprehensively, then the subject area can be described in this scheme. If not, the subject area should be characterised by examples of concepts: for example, if the subject area was life insurance, a potential knowledge asset might consist of a particular underwriter's knowledge of asbestos-related diseases, and key concepts would include "life expectancy", "interactions with other diseases", and "compensation payments".
- The *type* of the knowledge concerns whether it is explicit, implicit or tacit (for example, explicitly laid out in a text book, implicit in organisational practices, or whether an expert uses tacit heuristics that even he is not fully aware of); whether it is "what" knowledge (facts, judgements, relationships) or "how" knowledge (procedures, skills); and how much structure there is in the knowledge (for example, text is fairly unstructured, whereas a database is highly structured).
- The *quality* of the knowledge depends on its correctness (ranging from "logically proven" through "experimentally proven" and "best practice" down to "majority opinion", "opinion of expert" and ultimately "best guess"); on its completeness (compared with either current world knowledge on the topic or with potential knowledge on the topic); and on its currency (whether the knowledge is up to date). The last point is particularly

important, as the frequency and difficulty of keeping knowledge up to date can be a major factor in determining a knowledge asset management solution.

The availability of a knowledge asset depends on:

- the *times* at which knowledge is available (which may be very infrequent if the knowledge is in the head of a valuable, and busy, expert);
- the *form* in which the knowledge is held - on paper, in an expert's head, in electronic media, or "automated" in a knowledge based program;
- the *location* of the knowledge - in head office, in operational divisions world-wide, in the library.

When looking at the use of a knowledge asset, it is necessary to identify characteristics of each process that uses the knowledge asset:

- a *description of the task or process* that the knowledge is used for, e.g. assessing life expectancy of sufferers from asbestos-related diseases;
- the *task type* of the process; e.g. diagnosis, classification, design, planning;
- the *high-level business processes* which this process contributes to, e.g. the actuarial process;
- which *agents* apply the knowledge, e.g. an individual underwriter, a team of underwriters, a knowledge-based system;
- *frequency* of use of the knowledge;
- the *duration*, i.e. the time it takes to do the task.

5.1.2 Identifying Knowledge Management Related Processes

Having identified a knowledge asset, it is important to consider what existing knowledge management related processes are acting on the knowledge asset. To do this, it is necessary to consider if there are any processes which perform any of the following functions: develop the knowledge asset, preserve the asset, update the asset, use the asset, assess the asset, transfer the asset, or transform the asset. Figure 3 summarises the types of activity which comprise knowledge management related processes.

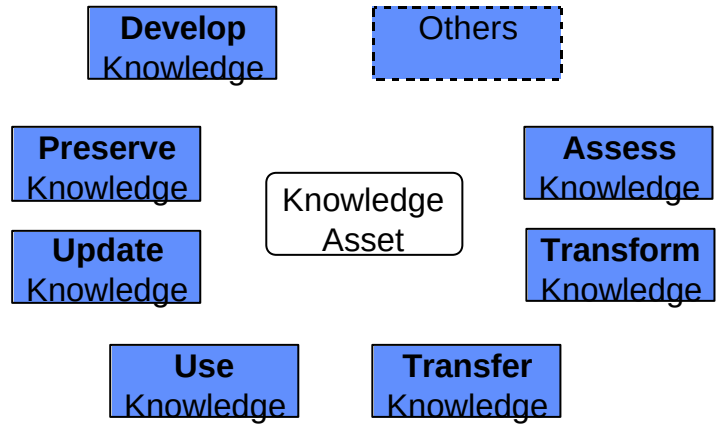

Figure 3: Knowledge related processes

To be more specific for each knowledge asset identified, consider if there are processes which perform any of the following activities:

- developing the knowledge asset for or within the organisation: acquiring, building, capturing, collecting, compiling, creating, discovering, eliciting, identifying, importing, learning;
- preserving the knowledge asset within the organisation: conserving, consolidating, holding, retaining, safeguarding, securing, storing, pooling;
- updating the knowledge asset within the organisation: evolving, growing, improving, maintaining, modifying, refining, refreshing;
- using the knowledge asset within or for the benefit of the organisation: applying, enacting, executing, exploiting, utilising;
- transferring the knowledge asset between members of the organisation, or between organisations: communicating, deploying, disseminating, distributing, exchanging, sharing;
- transforming the knowledge asset into a "better" format: compiling, explicating, formalising, standardising;
- assessing the knowledge asset: appraising, evaluating, validating, verifying;
- performing other functions on the knowledge asset: classifying, exploring, locating, monitoring, organising, retrieving.

If these functions are being carried out, then the next issue is whether they are being carried out efficiently and effectively. If these functions are not being carried out, or not being performed efficiently, then this highlights opportunities for better management of this knowledge asset.

5.1.3 Creating a Knowledge Table

This section gives an example of a checklist that can be used when identifying knowledge assets and related processes.

Knowledge Asset Characteristics:

Content:

- What **domain** is it about (e.g. powder processing)?
- What **type** of knowledge is it (implicit, explicit, heuristic, procedural, factual)?
- What is its **quality** (scope, completeness, correctness, up-to-date)?

Availability:

- When is it available (**time**)?
- What physical form is it in (**form**)?
- Where is it physically located (**location**)?

Knowledge Related Processes:

- How was the knowledge asset **developed**?
  For example:
  - Was it acquired?
  - Was it discovered?
  - Was it created?
  - Was it compiled?

- How is the knowledge asset **preserved**?
  For example:
  - How is it safeguarded?
  - How secure is it?

- How is the knowledge **updated**?
  For example:
  - What is the method for updating?
  - Why is it updated?
  - How easy is it to update?
  - How frequently does it need updating?
  - Whose responsibility is it for updating?

- How is the knowledge asset **used**?
  For example:
  - What real life task is it used for?
  - How frequently is it used?
  - Who/What applies the knowledge?
  - What is the duration of its application?

- How is the knowledge asset **transferred**?
  For example:
  - How is it communicated?
  - How is it shared?
  - How is it distributed?

- How is the knowledge asset **transformed**?
  For example:
  - How is it standardised?
  - How is it formalised?
  - How is it compiled?

- How is the knowledge **assessed**?
  For example:
  - How is it evaluated?
  - How is it validated?

Having answered some or all of the questions it is possible to make some decisions. Is this a real knowledge asset with high quality content? Is the knowledge available to be managed? Are there current processes in place which develop, preserve, update, use, transfer, transform and assess the knowledge, and are those processes themselves being performed well? If it is decided that a knowledge asset could be managed better than at present, then it's time to take it to the second stage: analysing the problems and opportunities which could be dealt with by better management of this knowledge asset.

5.2 Analysing Problems and Opportunities related to a Knowledge Asset

An important issue to address is "how can managing this knowledge asset add value to our organisation?" The answer is usually one of the following: "by relieving a knowledge bottleneck", "by plugging a knowledge gap", "by providing better quality knowledge" or "by communicating the knowledge better". In other words, every organisation has problems which could be overcome by better use of knowledge assets. The rest of this section considers each of these problem areas in turn, and consider where each one of them might arise within an organisation.

Knowledge Bottlenecks occur where there is a problem with knowledge availability. This is often because the knowledge is very specialised, and it resides in the heads of a few key individuals who are excessively busy at the best of times, and are not available at all outside normal working hours. However, knowledge bottlenecks may also arise if the source of the knowledge (whether it be expert individuals, databases, credit scoring systems, or whatever) is not available at the location where it is needed; an example can be found in some financial institutions, where applications for loans are received at the branches, but must be sent to Head Office for processing.

Knowledge Gaps occur where the knowledge is usually not present within an organisation - the decision makers know that they need the knowledge but recognise that they do not have it. This may occur because: new knowledge has arisen which requires a generalisation of existing procedures; no-one has investigated that area before; or because a key individual with unique knowledge has left the organisation.

Knowledge Quality issues usually arise when the knowledge is highly dynamic. Providing the best quality knowledge throughout the organisation therefore requires frequent updates to the knowledge, which may consume more time than the knowledge is worth, depending on the medium in which the knowledge is stored. It is also possible that knowledge quality issues may arise because an organisation is not using the best available knowledge. The most common reason for this is probably individual resistance, where new knowledge has arisen, but some decision makers prefer "the way we've always done it"; if the top decision makers are resistant to change, then the whole organisation will operate with sub-optimal knowledge. The next most common reason is probably information overload; there is too much information for a decision maker to process in the time available.

Knowledge Communication may be the biggest practical problem of all. Getting information and knowledge to where it is needed is a problem which needs to be solved (for example, U.K. building societies in the late 1980s had no shared record of "problem" applicants), but making the knowledge understandable is a bigger problem.

Having described the types of problems which can occur in an organisation, It is necessary to identify if any of these problems may be occurring in an organisation. The techniques for this are known business management techniques: SWOT analysis, value chain analysis, process simulation, checklists of bottlenecks.

5.2.1 Doing a SWOT Analysis

This section gives an example (Table 1) of the type of questions that should be asked when analysing knowledge assets and related processes using a Strengths, Weaknesses, Opportunities and Threats analysis.

Internal Strengths	**Internal Weaknesses**
Unique technique Leading edge Widely accessible to all who need it Can be validated In a form not vulnerable to loss Comprehensive ….	Difficult to perform - only a few people can do it - knowledge bottleneck Vulnerable to loss (if the expert leaves, the technique may remain, the expertise needed to adapt and update it may be lost) Knowledge gaps Inconsistent across the organisation Becomes out of date very quickly
External Opportunities	**External Threats**
Can be used to develop a new product Can be used to provide a new service Could be sold in its own right Could be patented …	Easily replicated by competitors External changes make it redundant Competitors could require patents Competitors may recruit your staff Could cause bad publicity …

Table 1: An example SWOT analysis

This analysis should help reveal whether there is a knowledge bottleneck or knowledge gaps, while the opportunities and threats give some indicators of the potential value of this knowledge asset to the organisation.

SWOT analyses provide most of the information needed to determine where knowledge asset management could benefit an organisation. Some of the other techniques listed above aim to assign values to knowledge assets, or to plan the introduction of new processes to manage knowledge assets. Whatever techniques are used, the end result should be a list of knowledge assets which the organisation wants to disseminate, apply, or otherwise manage more widely; the next stage is to select ways to leverage this knowledge asset.

5.3 Knowledge Asset Road Maps

We have used the ideas and techniques behind Technology Road Maps in order to provide a framework for developing Knowledge Asset Road Maps to support knowledge management initiatives. By carefully relating knowledge management actions upwards to

business objectives and strategies, and downwards to specific knowledge assets, a co-ordinated picture of the various parts of an organisation's overall knowledge management programme can be visualized and justified. Knowledge Asset Road Maps used as a strategic planning tool, allow the gaps between an organisation's current know-how and future requirements to be identified, and informed investment decisions to close this gap to be made.
They highlight the critical knowledge assets required by an organisation to meet market needs five to ten years in the future. They are mechanisms enabling organisations to visualise their critical knowledge assets, the relationships between these and the skills, competencies and technologies required to meet future market demands.

The Knowledge Asset Road Map allows:

- individual knowledge management actions to be defined and justified in terms of their contribution to the overall aims.
- effective communication of the work and progress on the programme to the participants and observers.
- management aids for those involved in carrying out the programme and measuring its progress.
- more effective communication between users, researchers, technicians, managers and directors involved in the various aspects of the programme.
- sensible decisions to be taken on the opportunities for further exploiting the results of the programme.
- the identification of knowledge gaps that need to be filled.

The Knowledge Asset Road Map should be owned by the organisation's Knowledge Development Manger. It is a living document regularly updated and serves as a framework for the monitoring of the knowledge management programme. The document reflects the current state of the interrelationships between work in progress and proposed for the future and the overall milestones and aims of the programme. Our work on knowledge management road maps is more fully described in Macintosh, Filby and Tate (1998).

6. Conclusions

In an ideal knowledge management oriented organisation there would an established organisational memory which would store knowledge assets (or pointers to them). There would be browsers, information processing agents and knowledge processing agents to support the use of the organisational memory. There would be automated, flexible workflow support to assist the knowledge worker. All this would appear seamless to the knowledge workers, i.e. it would be part of their everyday work to ensure that knowledge was shared and updated, etc. However, we are not in this ideal state. Much research is being carried in this area for example the work of Abecker, Bernardi, Hinkelmann, Kühn and Sintek, (1997) and Maurer and Dellen (1998) but we are not there yet. In the meantime it is important that knowledge-based organisations progress their knowledge management initiatives. This means:

- ensuring that the organisation starts to explicitly identify their knowledge assets and knowledge management related processes;

- ensuring that the organisation starts to control and manage these assets and processes;
- ensuring that professionals in the organisation are aware of the importance of the organisation's knowledge assets and are aware of existing knowledge management related processes.

This paper has described our teaching and dissemination concepts that support organisations make this start and ensure that knowledge management techniques are rolled out across the organisation. The paper identifies the types of personnel who need to be involved in a knowledge management initiative, gives a disciplined approach to knowledge management and importantly provides the personnel with the necessary training in the use of techniques to identify, analyse and improve knowledge assets.

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