The Role of Domain Expertise in Smart, User-sensitive, Health Information Portals

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Abstract

The provision of consumer health information portals acting as gateways to online resources is one strategy for enabling patients to be better informed and engaged in healthcare decision making and support. These portals need to be both smart and user sensitive, able to identify and select resources of relevance to a user community, describe them in ways that facilitate user assessments of quality and relevance, and provide efficient and effective search functionality that can be tailored to individual information needs. The domain expertise required to select and describe resources in this manner is a key to the efficacy of such portals, with their viability dependent on the sustainability and scalability of their resource identification, selection and description processes. This paper reports on a study of the domain expertise involved with the provision of an information portal for a breast cancer community undertaken as part of the Smart Information Portal Project.

1. Introduction

The modern malady of information overload in our digital and networked world is well documented. [1] The Internet provides multiple channels for creating, accessing, replicating and promulgating digital information but finding what we need to know when we need to know it has become more problematic. The ramifications are intensified when it comes to healthcare information. [2] How does someone recently diagnosed or managing an acute or chronic condition navigate their way through such an overabundance of information? How can they readily identify and access the resources which will aid their medical decision making, assist with self management and help them cope with their situation without being overwhelmed by the sheer volume of healthcare information available on the Web?

One strategy for addressing these issues is the provision of consumer-oriented online health information portals. Research into metadata driven, user-sensitive information retrieval in a breast cancer community context has demonstrated how this approach may better meet the information needs of healthcare consumers [3]. Further research is underway in the Smart Information Portal (SIP) Project relating to the development of a smart and user sensitive information portal that identifies and selects resources of relevance to a user community, describes them in ways that facilitates user assessments of quality and relevance, and provides efficient and effective search functionality that can be tailored to individual information needs.

Resource identification, selection and description processes are a key to the efficacy of a SIP. Creating and maintaining a knowledge repository of user centered resource descriptions requires domain expertise relating to the disease or condition and the portal’s user community. Knowledge of the medical, supportive and psychosocial information needs of the user community, along with empathy towards the lay person perspective in a medical situation is crucial. Expertise in methods to identify relevant resources and create the metadata that enriches the user experience and allows differentiated access based on personal information needs is critical. Understanding of the ever increasing dynamics, complexity and volumes of online health care information is also essential.

In order to develop a robust and sustainable SIP, a range of questions relating to the role of domain expertise need to be addressed. Can automated techniques replace or support the role of the domain expert in resource identification, selection and description? What aspects of domain expertise can be codified and represented in intelligent information technologies? What tools can be developed to support the role of the domain expert? What impact would the
provision of such tools have on the processes and on the SIP model in general?

To address these questions, a rich picture of domain expertise is essential. This paper reports on a qualitative study, undertaken as part of the SIP Project, of the resource identification, selection and description processes of the domain experts associated with the development of a user sensitive portal for a breast cancer community. The aim of the study was to gain an in-depth understanding of the role and attributes of domain experts, and the way in which intelligent information technologies and other tools might support them in populating the portal’s knowledge repository with user centered resource descriptions. The outcomes of this study will inform the development of the SIP specification, a major deliverable of the SIP Project.

In the next section a brief background to the development of the SIP concept is presented. This is followed by a description of the domain expert case study, its findings and the implications it has for a SIP specification. The paper concludes with some issues for further research.

2. Background

The Internet is playing an increasingly important role in healthcare. Government, commercial companies, medical organizations and consumer groups are making large quantities of healthcare information available online, partly motivated by the idea that informed patients are better able to participate in decisions surrounding treatment choices, monitor their own condition, and interact efficiently and effectively with medical professionals [4]. Governments are actively investing in and promoting online services as a way to contain escalating healthcare costs while also achieving better outcomes. Pharmaceutical companies and other medical industry bodies are also using the Internet to distribute information about diagnosis and treatment options. An example of this trend is the adoption of open access models by the publishers of medical journals to make their content freely available online a short time after print publication.

These developments give patients, their family, friends and carers unprecedented access to enormous volumes of healthcare information. Hence it is no surprise to see people heading online in the quest for information to aid in managing symptoms, understanding diagnoses, identifying and deciding on treatment options, dealing with treatment side effects and seeking psychosocial support [5]. Individuals are also willing to contribute to online information by sharing their healthcare experiences through email, community bulletin boards, discussion groups, blogs and newer social networking sites. The high regard in which the Internet is held by patients was reflected in a 2006 survey where a third of respondents indicated that medical advice or health information found online had significantly helped either themselves or someone close to them deal with their situation [6].

Some see the Internet as an enabler of a new medical paradigm which recognizes ‘the legitimacy of lay medical competence and autonomy’ [7]. In this community, the term e-patients has been coined ‘to describe individuals who are equipped, enabled, empowered and engaged in their health and health care decisions’ [8]. But being an e-patient is not easy given the overwhelming quantity and variable quality of health information available on the Internet. It requires expertise and skill, often only gained through the direct experience of living through one’s own adverse diagnosis or that of a loved one. E-patients need more than a Google search box to find relevant information in a timely manner and in a way that does not add stress to an already stressful situation. First-timers need guidance about the best places to go to find answers and to learn about what to search for. Where might they find the psychosocial support to help them cope with what they are going through? Where can they hear from people who have been through the same experience? They may also need help in assessing the fitness for purpose or quality of the information they have found. Is it current? Is it controversial? On what medical or other grounds is any advice based? Who are the authors and publishers and what are their credentials in the area? Many information services have been set up to provide consumer health information, but how well do they reflect the diversity of user’s information needs and values as opposed to those of the provider?

2.1. User sensitive approach

The Breast Cancer Knowledge Online Project [9] explored in depth the question of what it means for a healthcare information service to be user sensitive. It developed an information portal, BCKOnline (http://www.bckonline.monash.edu.au/), for breast cancer patients, their families, friends and carers using an iterative user-sensitive design approach. This sought at all stages to identify, address, and reflect the information needs and values of the target audience. The associated user consultation process established a set of principles on which the design and development of the portal was predicated, namely that:-

- information is essential for informed decision making and hence individual autonomy,
• information which leads to patient empowerment can also contribute to improved health outcomes,
• knowledge is contextual – its value to the individual is a dynamic interplay of personal, social, psychological, ethnic and cultural factors, and
• perspectives of people with direct and/or personal experience of breast cancer provides a valuable information resource and insight which both complements and enhances the scientific/biomedical view of breast cancer treatment, management and research.

The positive user evaluation of the resultant portal suggested that both the approach and the portal may form the foundation of a promising model for the provision of consumer health information services more reflective of varied user information needs and sensibilities [10].

2.2. Smart information portal

Drawing on the findings of the BCKOnline Project, the SIP Project is developing the concept of a smart and user sensitive information portal as a new form of online intelligent information system featuring:
• a gateway to a virtual, distributed knowledge repository of information resources highly relevant to the knowledge and decision support needs of particular communities,
• personalization based on a detailed, domain-specific user model and query extension capable of dynamically meeting individual information needs,
• relevance ranking of resources based not merely on a naïve match of term to content, but on user and resource attributes,
• value-added information about the reliability, provenance, authority and quality of the information resources accessible via the portal, and
• transparency through explanation of the knowledge available through the portal, and of the criteria used to select resources and assess their quality.

The combination of smart information technologies with the user sensitive approach may provide a means to better meet patient knowledge and decision-support needs while addressing issues regarding the quantity and quality of online information.

2.3. SIP knowledge repository

The knowledge repository at the heart of a smart information portal is the key to its efficacy (Figure 1). User and domain models are reflected in the methods for identifying and selecting resources of relevance for the user community and in the metadata schema that is used to produce standardized resource description. Resource descriptions reflect various ways of profiling the user community, with groupings identified through analysis of user information needs and values [3]. The sustainability and scalability of a SIP ultimately rests on the efficiency and effectiveness of the processes that populate the portal’s knowledge repository with user centered resource descriptions.

What are the information needs of those responsible for populating the knowledge repository of a SIP with user centered resource descriptions? What aspects of their domain expertise might be codified into information technologies? What impact would the availability of such tools have on the construction and configuration of SIP processes?

![Figure 1 Users of SIP Knowledge Repository](image)

3. Method

A qualitative study of the domain expert processes associated with the BCKOnline portal was undertaken to address these research questions. Reflecting the user sensitive approach taken in the development of the BCKOnline portal, the aim was to determine the information needs and values of the domain expert to contribute to the development of a specification of the technology required to support resource identification, selection and description processes for a SIP. In these processes the domain expert is the ‘user’ and so their information needs and interactions with information technologies are the focus of the study (see Figure 1).

The study of the domain expert processes of BCKOnline incorporated a series of semi-structured discussions, which included description and reflection on the roles domain experts have played in the design and development of the portal, an analysis of the metadata schema from the domain expert perspective, and a walkthrough of resource identification, selection description processes. A set of extensive notes were produced by the research team describing the discussions and highlighting the key issues that emerged. This was complemented by analysis of
relevant project documentation and of the BCKOnline portal itself.

In the discussions, the resource identification, selection and description processes were explained in depth and critiqued in the light of learning from their application in the BCKOnline portal and changes in web technologies since the portal was developed. This approach was taken in order to distinguish between the conceptual decision-making that went into the development of the portal and some of the pragmatic decisions taken in its implementation. In order to use the BCKOnline portal experience in the development of a SIP specification, it is necessary to recognize any compromises that went into the realization of its functionality, particularly identifying where the capabilities and limitations of the technology and resources available at the time of its development may have impacted on the design.

3.1. BCKOnline

The BCKOnline portal is designed to support the decision-making and supportive needs of breast cancer patients and survivors as well as their families, friends and carers. It can be considered as a ‘proto-SIP’ given the user sensitive approach to its design and development and its knowledge repository of user centered resource descriptions. In the BCKOnline portal, metadata is used to describe resources selected for inclusion in the knowledge repository from a user perspective. As well as a bibliographic description of the resource, this metadata encompasses description of audience, e.g. age group, stage of breast cancer, and information preference, and quality, e.g. credentials of author/publisher, its evidence basis, review processes, whether sources are attributed, whether it deals with a controversial issue, and its currency. Portal users can then profile their information needs against these attributes. The metadata schema governing resource description, the criteria for resource selection, and the subject coverage of the resources encapsulate resource, context and user models and were all informed by the user consultation undertaken throughout the development of the portal [3].

Resource identification, selection and description for BCKOnline are undertaken by domain experts, defined as 'women with first hand experience of breast cancer and extensive knowledge of the medical, supportive and psychosocial information needs of the breast cancer community’ [11]. These domain experts, after deeming a resource to be of relevance to the user community, use manual methods to essentially hand craft resource descriptions into a data entry template. While this creates the high value metadata that enables portal users to locate resources of relevance to their situation and make judgments as to their quality, it also limits the scalability of the approach and raises questions as to sustainability given the dynamics and extent of breast cancer information available on the Internet, along with changing user information needs.

As with many portal/digital library projects, the design and development focus of BCKOnline was on interfaces that make resource description available to end-users rather than on interfaces to support resource selection and metadata creation. While BCKOnline had undertaken extensive user information needs analysis, the needs of the domain experts responsible for resource selection and description were not studied in any detail. Undertaking such a study at this stage can therefore inform the development of the SIP model, and the further refinement of the BCKOnline portal. It can help to determine what automated tools and techniques may be useful for resource identification, selection and description processes.

3.2. Automating metadata creation

Although the creation of high quality resource descriptions is essential to the success of the SIP approach, the creation of such metadata can be burdensome and resource intensive leading to bottlenecks which impact on their usefulness [12]. Much research into automated methods of extracting or deriving metadata from information objects has been undertaken to overcome these issues [13]. While some effectiveness and efficiencies have been demonstrated, these techniques tend to be less successful where metadata values rely on the intellectual discretion of humans [12]. There is an emerging consensus that the smarter approach is to look at how the human and machine can complement one another, as the following quote illustrates:-

'It is clear from research and the experience of users that automatic machine-based indexing and human intellectual analysis-based indexing both make important, but very different, contributions to successful information retrieval. At the same time, expert human indexing keeps getting more expensive, while automatic indexing becomes, comparatively, less and less expensive and more effective. Therefore, it seems likely that future IR databases will seek to maximize benefits by allocating human analysis and indexing to situations where the benefits of human expertise are most apparent and immediate.' [14]

One of the benefits of applying automated techniques in the right situations is that it may enable the human indexer to take on the role of a ‘reader adviser’, concentrating their efforts on adding highly valued metadata ‘identifying themes, relationships,
methodological approaches, points of view, prejudices, biases, slants, purposes, values, and qualitative aspects that cannot be easily identified through automatic techniques’ [14]. It may therefore allow users to reap the rewards of richer rather than minimal resource description frameworks.

This reflects the situation with BCKOnline and the SIP concept, where the domain expert is populating the description, quality and audience elements of the metadata schema with values to aid portal users in judging the relevance of a resource to their situation, and its fitness for their purposes.

The need for research into metadata creation workflows has been identified in order to determine how human and machine techniques and resources may be optimally configured [12]. In contrast to the amount of research on automated techniques, there is a noticeable lack of research on the usability of metadata creation applications [15].

4. Findings

The case study emphasized the pivotal role domain expertise had played in the design of the knowledge repository of the BCKOnline portal, including the translation of the results of the user information needs analysis into the metadata schema and selection criteria, as well as applying domain knowledge to resource identification, selection and description processes. It highlighted the need for involvement of domain expertise from the inception of a SIP. It was also evident that the BCKOnline domain experts brought a special combination of skills to the development of the portal, so the first analysis task focused on identifying and defining domain expertise attributes relevant to healthcare domains.

4.1. Attributes of domain expertise

The following attributes of BCKOnline domain expertise were identified from analyzing the discussions and other project documentation.

1. Medical and lay expertise. The BCKOnline resource identification, selection and description processes are all based on an intimate knowledge of the breast cancer experience from both medical and lay perspectives.

2. User advocacy. The BCKOnline domain experts also saw their role as one of advocacy for the portal users. This involves empowering the user both in terms of providing access to resources which will assist them in navigating through often confusing health systems and treatments, as well as ensuring that information resources are available which counterbalance any media hype or over effusive medical releases. The overall objective is information which empowers the user through its relevance, range, and comprehensibility. Advocacy may also involve highlighting political issues – for example the release of new drugs and the processes involved; shortcomings in current practices; and critiques of current methodologies/studies. The objective again, is to foster informed patients who are thus able to make decisions based on awareness and understanding of the issues.

3. Awareness of the kinds and styles of information most valued by the portal’s user community. With the plethora of information about breast cancer available online, resource selection is influenced by topic, tone and type. The desire is to include resources that are not ‘patronizing’ and that feature ‘lesser’ or local voices. Diversity of format, tone and style across topic areas were sought to cater for different information preferences and modes of user learning [16].

4. Connection into a range of information networks. Satisfying user information needs and values requires monitoring of a range of channels in which information about resources of relevance may be found. This information seeking is also part of maintaining their domain expertise and is discussed in more detail in the section 4.2.

5. Understanding of health informatics. To identify, select and describe representative resources, the domain expert requires knowledge of the structure and nature of health information systems in their domain. An awareness of the various sources of healthcare information and their strengths, weaknesses, biases and limitations is required in order to identify potential resources and to critically appraise them. While the approach puts final judgments of quality into the hands of the user, the selection criteria for the different types of resources does represent a threshold quality respectful of the need for healthcare information to have integrity and accuracy.

6. Knowledge of information management principles. The library background of the BCKOnline domain experts meant that they brought to the project experience in
Classification and indexing principles, and awareness of their impact on precision and recall. Precision refers to search accuracy (the percentage of relevant items in a result set) whereas recall relates to search coverage (the percentage of relevant items retrieved in a result set out of all relevant items in a database). Indexing and information retrieval practices involve making trade-offs between them. Also of importance is an appreciation of the changes digital and networked technologies are having on traditional practices and the new possibilities they engender.

Implications for the SIP specification: Medical expertise, lay expertise and information management expertise make up the domain expertise involved in the design and development of the knowledge repository of the BCKOnline portal. It is an inordinate requirement to expect to have access to individuals with highly developed skills in all these areas, either for the purpose of expanding the pool of those involved in resource identification, selection and description for BCKOnline or replicating the approach in other healthcare domains. This suggests that the domain expert interface must have capabilities that support learning. It must enable those with the responsibility of resource identification, selection and description for a SIP to develop their skills in the areas in which they are less expert.

Quadrant diagrams can be used to represent the interplay between aspects of domain expertise. The first diagram (Figure 2) plots information management expertise against combined medical and lay expertise. As shown in the examples noted in each of the quadrants, it can be applied to others involved in the development and use of a SIP. For example those involved in developing the SIP specification have expertise in information management but are lacking in medical and/or lay expertise of particular diseases or conditions. Given the importance of medical knowledge being applied in a SIP in a way that is empathetic to the portal’s user community, the second diagram (Figure 3) further dissects the disease/condition expertise, plotting medical versus lay expertise.

These diagrams can act as diagnostic tools for SIP implementations. For example, they allow for the skills of those involved in a portal development to be plotted across the three dimensions. This allows for any gaps to be identified and addressed, through bringing into the portal team the necessary expertise and/or ensuring that the domain expert interface can support such learning. They could also be used to configure domain expertise within a SIP implementation and guide the assignment of parts of resource identification, selection and description processes to individuals with the requisite expertise, including contributions from the user community.

4.2. Domain expert information seeking behavior

Another finding from the study was the contrast between the information seeking practices of the BCKOnline domain expert and that of healthcare consumers who might start their quest for information at one of the major search engines [17, 18]. For the BCKOnline domain expert the major search engines tend to be the ‘last resort’, as experience has shown that the ranking algorithms are not attuned to their
Information needs. The domain expert is often looking for local, new or specialized material with a tone that is empathetic to the patient or lay perspective. So rather than trawl through pages and pages of search engine results pointing to traditional and mainstream resources, they will often head directly to their own trusted sources first.

BCKOnline domain experts are continually monitoring a variety of channels to identify resources of interest for themselves and the BCKOnline user community. They subscribe to a number of alert services – e.g. current contents of medical journals, breast cancer alerts, and bulletin boards – and routinely visit various government and cancer organization websites to see what is new. They may also use personal communications with medical professionals to deal with individual queries.

Implications for the SIP specification: This suggests that the domain expert interface for populating the knowledge repository of a SIP should allow for the monitoring of a range of information channels for resources of relevance to the portal’s user community. This kind of resource brokering functionality is important, not just to locate resources of relevance to the user community, but also to maintain and build expertise in a healthcare domain.

To readily search for a topic across these information channels would also be a useful capability.

4.3. Topic coverage of the knowledge repository

One of the key issues the domain expert has to consider in populating the knowledge repository is its coverage. What range of topics should it cover? In the case of BCKOnline, resource selection was informed by data collected in the initial interviews and focus groups conducted in the early stages of the project [19]. This data was used to produce target numbers of resources for various breast cancer topics and audiences which guided initial resource identification and selection processes.

This raised some interesting issues about the difference in resource selection practices in the initial setup of the BCKOnline knowledge repository versus those now employed to maintain its currency and coverage. Having established a base set of resources to cover core topics, when the domain expert is alerted to newly published resources in the same vein they are not automatically included in the repository. This led to a discussion of whether the manual processes for resource description were inhibiting the addition of these resources to the knowledge repository or whether adding large quantities of essentially similar resources went against the role of the portal in shielding the user from information overload.

A specific example of such a resource came up in a subsequent walkthrough of resource description with the serendipitous find of an information sheet covering the basics of breast cancer, newly produced by one of Australia’s colleges of doctors. Despite the topic being well covered by other resources in the knowledge repository, it was added to the list for inclusion given its relevance to local audiences and the inclusion of graphics which are highly valued by the portal users. This highlights the tension inherent in the SIP model between keeping the numbers of resources manageable and highly relevant from a user perspective to aid precision versus attempting all-inclusive coverage to support recall. The aim in BCKOnline is to be representative of a range of views rather than exhaustive, to privilege precision over recall.

Implications for the SIP specification: The domain expert interface of a SIP should therefore have mechanisms to view the coverage of topics represented in the knowledge repository. It should also provide feedback on use of the portal, i.e. search terms input by portal users and their use of the user/resource categories. Resource identification and selection practices can be informed by this ongoing tracking of user information needs and how that matches to the topic coverage of the knowledge repository. In addition with its commitment to transparency, a SIP should also declare the way in which it monitors user behavior, why this data adds to the user experience, and where appropriate provide mechanisms to opt in or opt out.

Applying automation techniques to resource description processes may result in the cost of manual metadata creation no longer being the determining factor for including resources of a similar vein to others already in the SIP knowledge repository. This gives rise to the possibility of some interesting personalization features, if two tiers of resource description are considered. Metadata brokering could allow for a stub description of a resource to be created, which could then be augmented at a later date. This augmentation could be based on the popularity of the resource or, if user annotation features are considered, be left up to trusted expert users. Portal users could then have the choice of including these second tier resources in their queries when exhaustivity is important to their needs. An example of this combination of manual and automated resource description can be seen in the INFOMINE virtual library of scholarly Internet resources [20]. However in applying this to a SIP, care has to be taken to ensure that information overload is not replaced with functionality overload.
4.4. Vocabulary management

Another issue identified in the study was the need for better vocabulary management and subject indexing capabilities. *BCKOnline* features an interesting combination of three kinds of subject encoding schemes [21]. The first is a combination of terms from the BreastCare Victoria Glossary (BVG) and MESH, the international standard for the classification of medical knowledge. The BVG terms attempt to overcome the limitations of MESH when applied into an Australian and consumer context, as the MESH terms are just not representative of what portal users are likely to type into the search box.

The second subject encoding scheme, *BCKOnline* Key Words, is for capturing indexing terms not covered by the BVG or MESH terms, e.g. common usage terms, and terms relating to the psychosocial or the facilitative nature of resource and again reflective of the terms portal users will be searching for. These terms emerged through the description processes and so can be considered a form of domain expert tagging and result in a folksonomy, an emergent rather than a pre-determined controlled vocabulary. This hybrid of taxonomy and folksonomy allows for good information management practices that balance precision and recall to be combined with flexibility and responsiveness to the changing needs of users. In addition the exposure of the user to medical vocabularies may aid in their information seeking outside of the portal. It is an example of how the portal can act as a learning system, enabling the user to move from being a novice to a more experienced user and potentially improve their information seeking activities beyond the portal’s bounds.

The third subject encoding scheme is the *BCKOnline Disease Trajectory Scheme* which consists of 13 broad categories relating to types of breast cancer, stages of breast cancer treatment and aspects of psychosocial support. The decision not to use these categories in the user interface as a navigation mechanism was discussed as an example of how constraints in the original development of the portal led to a desirable feature being shelved.

A desire for subject indexing to be informed by feedback from the user on search terms was also discussed, as was the ability to add more meaning to the indexing where applicable. It would be useful to be able to indicate the kind of relationship between a resource and a term and/or the attributes of the resource to which it applies as this would lead to greater precision in user querying.

*Implications for the SIP specification:* Better vocabulary management capabilities are highly desirable given the importance of the subject indexing to the user search functionality [21]. The glossary interface in *BCKOnline* is rudimentary and offers no feedback on how terms have been applied in order to encourage consistency, nor the ability to access feedback on the search terms of portal users. It also does not allow for relationships between terms to be captured for exploitation in search strategies and as part of the codification of domain expertise. The use of a sophisticated vocabulary management tool in the development and maintenance of the portal’s indexing vocabulary and its application to resource description are examples of how both the domain expert and the end user could benefit from the application of some smarter capabilities. A SIP might also benefit from the incorporation of emerging semantic web technologies that aim to foster richer assertions being made about information objects in a manner that machines can manipulate [22].

4.5. Resource Identification, Selection and Description as Connected Processes

The domain expert study revealed that resource identification, selection and description are entwined rather than discrete processes. Determining whether a resource meets the selection criteria overlaps with the describing of a resource, especially with respect to its quality, subject and audience attributes. As noted above resource identification and selection can benefit from feedback on subject indexing, while subject indexing itself can benefit from feedback on the terms users type into the search box. This suggests that domain expert and user processes are also inter-related.

The need for tools to aid in monitoring and maintaining the knowledge repository and to ensure it is responsive to user needs was discussed. This may involve weeding out resources that are no longer available or changing their currency or controversial status in response to developments in the domain.

*Implications for the SIP specification:* The connections between processes suggest that a service oriented approach to the architecture of a SIP may be beneficial [23]. This would enable domain expert and user interfaces to share a suite of common components. It would also enable them to be more configurable to the particular needs of a healthcare domain or user community.

5. Domain expert dashboard

The findings of the domain expert study have been used to produce a conceptual specification of a domain expert interface to the knowledge repository for a SIP (Figure 4). It has been named a *domain expert*
**dashboard** to convey its functionality in enabling a domain expert to monitor and interact with the various facets of the knowledge repository, as well as tracking and receiving inputs from other information channels. The dashboard concept also captures the manner in which components interact to deliver the desired smart and user sensitive capabilities into both domain expert and end user interfaces.

The dashboard features tools for:

a) Vocabulary management – to aid in developing and maintaining the portal’s subject indexing vocabulary, ensuring it is sensitive to user needs, and capturing relationships to other vocabularies in the domain.

b) Use and user analysis – to monitor and analyze user information needs and search behavior.

c) Resource brokering – to support resource identification and maintenance of domain expertise through monitoring of appropriate information channels.

d) Metadata brokering – to apply automated techniques into resource description.

e) Managing the quality framework – a quality assessment tool for resource evaluation and description.

![Figure 4 Domain expert dashboard](image)

It is envisaged that in a service oriented environment, these components could be assembled into resource identification, selection and description services and will be maintained through a suite of management services. In this conceptualisation the knowledge repository of a SIP is also extended to encompass user centered resource descriptions, value encoding schemes, and user logs controlled by a series of schemas. The idea is that declaring and managing the schemas of the knowledge repository in this way will allow for them to be more flexible and responsive to changes in resource and user needs. Optional components – a digital repository of resources, a register of domain expert information sources, and repository of user annotations – have also been flagged. The intention is to further develop this conceptualisation through the prototyping of some of the components within the Smart Information Portal Project.

### 6. Conclusion

The concept of smart and user sensitive consumer health information portals has been enriched by this study of domain expertise. It has revealed the dimensions of expertise that needs to go into the provision of such services and helped to develop a specification for the interface required to support resource identification, selection and description processes.

The study suggests that the technological components of a SIP should be viewed as dynamic and connected rather than static and discrete. In this way the portal can be flexible and responsive to user information needs, developments in healthcare domains and allow the domain expert to deal with the dynamics and diversity of online information. On this last point, Web 2.0 attitudes and technologies present particular challenges and opportunities for the SIP concept. This research should help in the assessment of the applicability of Web 2.0 tools and other intelligent techniques in sustaining resource identification, selection and description processes.

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